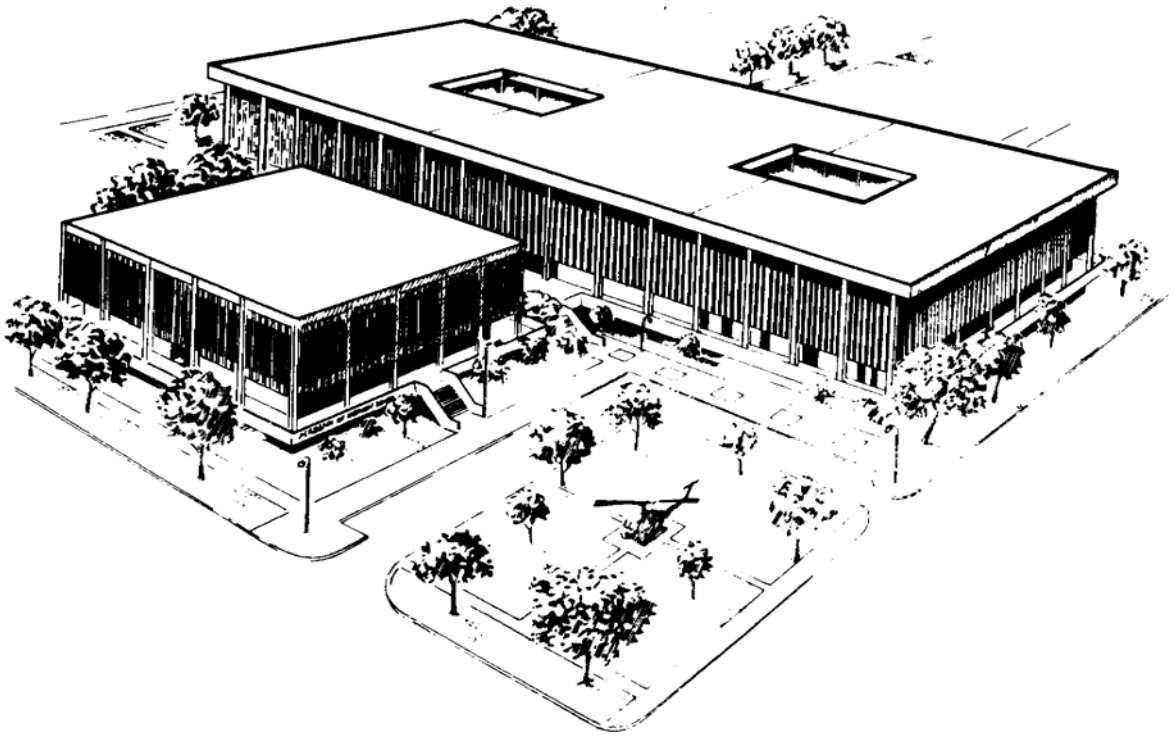
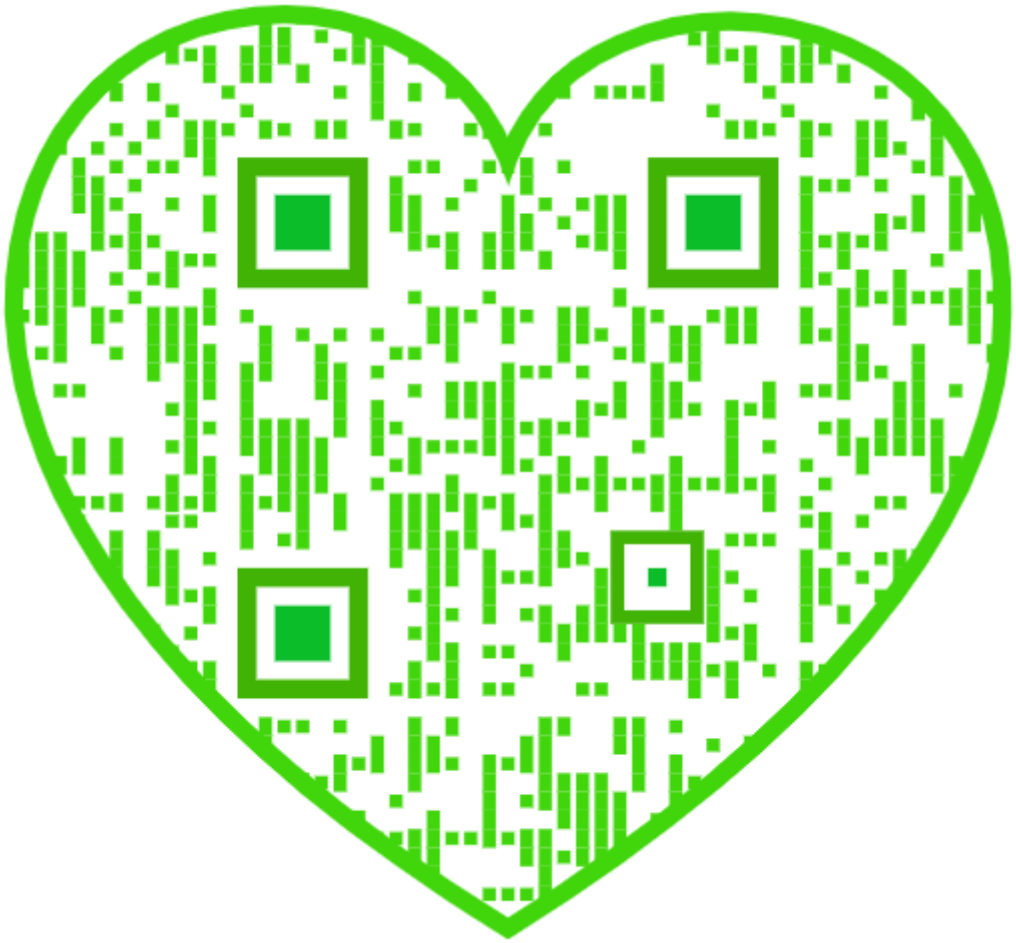
U.S. ARMY MEDICAL DEPARTMENT CENTER AND SCHOOL
FORT SAM HOUSTON, TEXAS 78234-6100



SPECIAL SURGICAL PROCEDURES I

SUBCOURSE MD0927 EDITION 100



DEVELOPMENT

This subcourse is approved for resident and correspondence course instruction. It reflects the current thought of the Academy of Health Sciences and conforms to printed Department of the Army doctrine as closely as currently possible. Development and progress render such doctrine continuously subject to change.

ADMINISTRATION

For comments or questions regarding enrollment, student records, or shipments, contact the Nonresident Instruction Section at DSN 471-5877, commercial (210) 221-5877, toll-free 1-800-344-2380; fax: 210-221-4012 or DSN 471-4012, e-mail accp@amedd.army.mil, or write to:

COMMANDER
AMEDDC&S
ATTN MCCS HSN
2105 11TH STREET SUITE 4192
FORT SAM HOUSTON TX 78234-5064

Approved students whose enrollments remain in good standing may apply to the Nonresident Instruction Section for subsequent courses by telephone, letter, or e-mail.

Be sure your social security number is on all correspondence sent to the Academy of Health Sciences.

CLARIFICATION OF TRAINING LITERATURE TERMINOLOGY

When used in this publication, words such as "he," "him," "his," and "men" are intended to include both the masculine and feminine genders, unless specifically stated otherwise or when obvious in context.

.

USE OF PROPRIETARY NAMES

The initial letters of the names of some products are capitalized in this subcourse. Such names are proprietary names, that is, brandnames or trademarks. Proprietary names have been used in this subcourse only to make it a more effective learning aid. The use of any name, proprietary or otherwise, should not be interpreted as an endorsement, deprecation, or criticism of a product. Nor should such use be considered to interpret the validity of proprietary rights in a name, whether it is registered or not.

ACKNOWLEDGEMENT

Portions of this sub-course are extracted from FM 8-73 and FM 8-74, which are copyrighted textbooks. This material may not be sold, commercially used, or copied.

.

TABLE OF CONTENTS

Lesson			Paragraphs
	INTRODUCTION		
1	PROCEDURES IN PREPARING THE PATIENT		
	Section I.	Introduction	1-1--1-7
	Section II.	Preparation of The Patient for Surgery	1-8--1-12
	Section III.	Surgical Positions	1-13--1-23
	Section IV.	Draping the Patient	1-24--1-27
	Exercises		
2	PROCEDURES IN PREPARING MATERIALS		
	Section I.	Information on File	2-1--2-2
	Section II.	Handling and Use of Sutures	2-3--2-10
	Section III.	Preparation of Specimens	2-11--2-13
	Exercises		
3	PROCEDURES IN ANESTHESIA AND PARENTERAL THERAPY		
	Section I.	Introduction	3-1--3-5
	Section II.	Regional Anesthesia	3-6--3-19
	Section III.	General Anesthesia	3-20--3-28
	Section IV.	Emergencies in Anesthesia	3-29--3-34
	Section V.	Parenteral Therapy	3-35--3-50
	Exercises		
4	PROCEDURES IN GENERAL SURGERY		4-1--4-16
	Exercises		
5	PROCEDURES IN ORTHOPEDICS		
	Section I.	General Orthopedic Surgery	5-1--5-10
	Section II.	Surgery of the Hip	5-11--5-17
	Section III.	Operations on the Tibia	5-18--5-20
	Section IV.	Operations of the Knee	5-21--5-25
	Section V.	Operations on the Ankle and Foot	5-26--5-28
	Section VI.	Operations on the Shoulder, Arm, Forearm, and Wrist	5-29--5-31
	Section VII.	Plastic and Amputation Procedures	5-32--5-33
	Section VIII.	Application of Plaster Casts	5-34--5-40
	Exercises		

CORRESPONDENCE COURSE OF THE
U.S. ARMY MEDICAL DEPARTMENT CENTER AND SCHOOL

SUBCOURSE MD0927

SPECIAL SURGICAL PROCEDURES I

INTRODUCTION

Any patient who is scheduled to have surgery poses special challenges to personnel entrusted with his care. Every procedure done by (OR) operating room personnel for the patient's operation--from the preoperative skin prep to final closure of the incision--requires thorough mastery of many precision techniques and uncompromising attention to detail in order to safeguard the patient. While in the OR, the patient is cared for by a highly trained team that must function as a unit if the patient's best interest is to be served. You, the OR specialist, are a member of this team.

Many demands are placed upon the OR specialist whether he is assigned as the scrub, circulator, or in some other capacity. Various factors, including the individual situation and the clinical specialty into which the surgery is classified, influence the actions expected and required of the OR specialist.

The purpose of this subcourse is to familiarize you with the roles of the OR specialist in the preparation for and performance of a number of special surgical procedures.

Portions of this subcourse are extracted from FM 8-73 and FM 8-74, which are copyrighted textbooks. This material may not be sold, commercially used, or copied.

Subcourse Components:

This subcourse consists of five lessons. The lessons are as follows:

Lesson 1	Procedures in Preparing the Patient.
Lesson 2	Procedures in Preparing Materials.
Lesson 3	Procedures in Anesthesia and Parenteral Therapy.
Lesson 4	Procedures in General Surgery.
Lesson 5	Procedures in Orthopedics.

Credit Awarded:

To receive credit hours, you must be officially enrolled and complete an examination furnished by the Nonresident Instruction Section at Fort Sam Houston, Texas. Upon successful completion of the examination for this subcourse, you will be awarded 14 credit hours.

You can enroll by going to the web site http://atrrs.army.mil and enrolling under "Self Development" (School Code 555).

A listing of correspondence courses and subcourses available through the Nonresident Instruction Section is found in Chapter 4 of DA Pamphlet 350-59, Army Correspondence Course Program Catalog. The DA PAM is available at the following website: http://www.usapa.army.mil/pdffiles/p350-59.pdf.

LESSON ASSIGNMENT

LESSON 1	Procedures in Preparing the Patient.
LESSON ASSIGNMENT	Paragraphs 1-1 through 1-27.
LESSON OBJECTIVES	After completing this lesson, you should be able to:

1-1. Identify common anesthesia terms and their definitions.

1-2. Identify proper procedures for performing a preoperative skin prep.

1-3. Identify equipment used in positioning patients.

1-4. Identify procedures for placing a patient in the supine, Trendelenburg, reverse Trendelenburg, lateral kidney, lateral chest, lithotomy, prone, jackknife, and sitting positions and position for spinal anesthesia.

1-5. Identify procedures for draping a patient.

SUGGESTION

After completing the assignment, complete the exercises at the end of this lesson. These exercises will help you to achieve the lesson objectives.

LESSON 1

PROCEDURES IN PREPARING THE PATIENT

Section I. INTRODUCTION

1-1. PURPOSE AND SCOPE

This subcourse and subcourse MD0928 deal with the care of the patient in the OR preceding and during surgery. They deal particularly with procedures in surgery and emphasize the role of the OR specialist. Principles, techniques, and procedures peculiar to the care of the patient in the OR are emphasized. Nursing care given the surgical patient by ward personnel is mentioned when appropriate--and this care is important in the cycle of care of the surgical patient--but details are omitted in order to not duplicate instruction presented in other subcourses. For the same reason, details concerning the preparation of materials by the centralized materiel section are omitted. In accordance with the above information, this subcourse is directed towards the OR specialist whose principal duties are performed in the OR.

1-2. OPERATING ROOM TEAM

The OR specialist is a member of a patient care team. In various ways, all team members assist in the care and treatment of the patient during surgery. The team is assisted and supported by other teams and components of the hospital. The team in the OR performs certain tasks in the care of the surgical patient while he is in the OR. This team usually includes a surgeon (medical officer), who may be assisted by other medical officers (such as first and second assistants); an anesthesiologist (medical officer whose specialty is anesthesia) or anesthetist (AN officer holding military occupational specialty title "anesthetist"), or other persons who administers anesthesia, and therefore serves as an anesthetist (such as the surgeon); a "scrubbed" ("sterile") worker (either an OR specialist, or an officer or both may serve in this capacity depending upon the needs of the operation); a circulator (OR specialist or professional registered nurse); and other team members as appropriate for the surgical procedure.

1-3. THE ROLE OF THE OPERATING ROOM SPECIALIST

Because of his role in the care of the patient during surgery, the OR specialist requires mastery of a number of procedures, all of which embody certain principles and techniques. The overriding principle that should guide the specialist in the performance of every task connected with the patient's surgery is the maintenance of asepsis. The specialist may abandon aseptic techniques only upon order by the surgeon. The surgeon may sacrifice aseptic technique during grave emergency when the time element is paramount in resuscitating the patient, such as during cardiac arrest.

1-4. TERMINOLOGY

a. **General.** Certain terms that have to do with anesthesia appear frequently in the following text. Use of these terms in this portion of the text is not to introduce the subject of anesthesia. Rather, the terms are used either to show the sequence of events or to indicate the reason for variations in procedure. However, knowledge of these terms should enhance the specialist's understanding of the procedures discussed. Other terminology related to anesthesia is presented in Lesson 3.

b. **Anesthesia.** A bodily state in which sensation is absent to the extent that the patient does not experience pain during a surgical procedure. A description of general, regional, and spinal anesthesia follows:

(1) General anesthesia. Anesthesia achieved by producing the loss of all modalities (means) of sensation, including loss of consciousness.

(2) Local anesthesia. Anesthesia confined to one part of the body with administration of the anesthetic agent by topical application, local infiltration, subcutaneous injection, nerve block (see (3) below), or epidural or spinal injection. Local anesthesia may also be accomplished by refrigeration, which is the application of a low temperature (perhaps by packing a limb in ice) to a part of the body to anesthetize it.

(3) Spinal anesthesia. Anesthesia achieved by blocking nerve conduction within the spinal canal.

c. **Anesthetize.** To anesthetize a patient is to place him in a state of anesthesia.

d. **Anesthesiologist**. A medical doctor that specializes in the art and science of administering anesthetics to produce the various stages of anesthesia.

e. **Anesthetist.** Although anesthesia is often administered by an anesthesiologist, the term "anesthetist" is used throughout this text to indicate the person who administers anesthesia.

1-5. SPECIALIST-PATIENT RELATIONSHIP

One aspect important in the care of the surgical patient is the relationship between the specialist and the patient. Although the OR specialist may be with the patient for only relatively brief periods before anesthesia is administered to the patient, these contacts have important meaning for the patient. For this reason, the specialist, through both attitude and deed, can do much to help (or hinder) the patient through a successful operative procedure and thus toward recovery from his illness.

1-6. THE PATIENT

The patient's mental attitude is influenced by normal fears such as the fear of general anesthesia and surgery, fear of pain, disability, disfigurement, the unknown, and especially the fear of death. Hospitalization is an abnormal way of life for him, and the very fact that he is losing his independence for a time and placing himself completely in the hands of other persons contributes to his anxiety. He does not always understand what is going on and is apt to feel lost and fearful. Patients manifest anxiety in different ways. Some patients express their fears and are openly anxious, while others are openly hostile. Some appear quite calm and seem to have little or no feeling about the pending surgery.

1-7. THE OPERATING ROOM SPECIALIST

The specialist must always bear in mind that the patient is a person, not just an operative procedure, and that the surgery for which he is scheduled is a major occurrence to him. The specialist should be aware of the various kinds of behavior the patient may manifest and accept the patient as he is. The treatment of emotional and behavioral problems is the responsibility of others, but approaching the patient with a confident manner, telling him what is going to be done, and performing all procedures in a quiet, systematic, thorough way while demonstrating sincere kindness, sympathy, and simple courtesy are effective means for dealing with the patient's anxiety in the specialist-patient relationship. If the patient is convinced that the members of the surgical team are interested in him as a person rather than as an operative procedure, the first step toward a successful operation and his ultimate return to health is accomplished.

Section II. PREPARATION OF THE PATIENT FOR SURGERY

1-8. INTRODUCTION

The skin is the body's first line of defense against bacterial invasion. A break in the skin, even though it is a surgical incision made with a sterile instrument, may permit microorganisms to enter the body. The human, living skin cannot be sterilized. However, it can be rendered "surgically clean." If skin is not prepared properly prior to surgery, infection may result from the bacteria present on the patient's skin. The first step in this preparation of the patient's skin is to shave the hair on and around the operative site. This not only helps to lower the population of bacteria, but also helps to prevent hairs entering the wound as foreign bodies. In addition, preparation of the patient for surgery includes a number of procedures--all of them important in the chain of asepsis that protects the patient's life and contributes to his smooth recovery. The aspects of preparation given consideration in this section relate to (1) the patient's mental preparation and (2) principles and techniques of skin preparation ("prep") for surgery.

1-9. MENTAL PREPARATION

The first opportunity that the OR specialist has to begin building a trusting relationship between himself and the patient occurs during the patient's preoperative skin preparation. Throughout this preparation, the specialist should within the limits of the situation and his own capabilities answer the patient's questions about pending surgery. The patient will have more confidence in the specialist who is honest than in one who fabricates answers. Therefore, the specialist must not guess or speculate about matters of which he has little or no knowledge. Throughout the relationship, the specialist must show by his actions, attitudes, and words that he appreciates the seriousness of the situation; and that he shows confidence and expectancy that the planned surgical treatment will be successful.

1-10. PREOPERATIVE SKIN PREPARATION (PREP)

a. **General.** The starting point in the chain of asepsis, the patient's preoperative skin prep, consists of cleansing and shaving the area of the operative site. The purpose of the prep is to render the operative site as clean and free from bacteria as possible and therefore reduce the possibility of infection. Thus, it is obvious that the shaving and cleansing of the skin must be performed with utmost care and skill. The OR specialist normally does the shave prep on the day prior to surgery.

b. **Assignment of Preps.** The preps may be listed on a daily duty roster and may be assigned along with other duties on the nursing service assignment roster. After the assignment has been made, the specialist checks the OR schedule for the following day. Information provided on the schedule includes the number and types of operations and, therefore, the number and types of preps. The schedule also gives the location of the patient to be prepped. The specialist should also note the scheduling of spinal anesthesia because these patients will need an 8-inch square area in the lumbar region prepped. When the specialist is assigned several preps, he should either take a copy of the schedule along or write the information on a sheet of paper. This will help to alleviate errors.

(1) Preparation of the patient's skin for surgery is a treatment procedure; therefore, it must be initiated by an order of the medical officer. The order may be written "routine prep," which would necessitate the use of a standing operating procedure (SOP) to delineate the area; or instructions that are more specific may be included.

(2) Some medical officers may outline areas to be prepared using skin marking pencils. This procedure is seen most often in neurosurgery.

c. **Local Policy.** After checking the assignment roster and determining what his duties are, the specialist should refer to the local policy to know just how the preps are to be done. This information, which may be listed on a series of cards or in a manual,

includes the following: the areas to be prepped for various operations, any special instructions, and the procedure to be followed for unusual situations.

(1) Area of prep. The anatomic area of skin preparation is dictated by the operative procedure and its approach. A general guideline that can be followed is to prepare an area "far and wide." More specifically, an SOP usually outlines the area to be prepared for specific operations. The following examples are generally accepted as appropriate for the various types of surgery (see figure1-1).

(a) For abdominal surgery, the male patient's skin is shaved and cleaned from the nipple line to the upper third of the thigh, including the pubes (hair over the pubic regions) from side to side anteriorly (see figure 1-1 A). For a female, the upper boundary is the breast fold on the chest wall (see figure 1-1 B). Particular care must be taken to assure adequate cleaning of crevices and indentations in the skin. An example on the abdomen is the umbilicus.

(b) For kidney operations and surgery of the proximal third of the ureters, the skin is shaved from the axilla (which is prepped) to the groin (see figures 1-1 C and D).

(c) For chest surgery, the skin is shaved and cleansed on the affected side from midhip over the shoulder, including the axilla, to the shoulder on the unaffected side (see figures 1-1 E and F).

(d) For rectal surgery, support the legs and thighs in the lithotomy position (see figure 1-10). Shave the pubic, perineal, thigh, and anal areas (in a radius of about 10 inches from the anus) (see figures 1-1 G and H).

(e) For gynecological surgery (perineal prep) (see figure 1-1 I), support legs and thighs in the lithotomy position and shave the anterior surface from the umbilicus down: the pubic area, the external genitalia, the perineum, including the area around the anus, and the buttocks. Shave inner thighs halfway to the knees from the middle of anterior to middle of posterior thighs.

(f) For surgery of the cranium (see figure 1-1 J), follow the outline indicated by the surgeon. Clip the hair before attempting to shave the scalp. Find out if long hair is to be saved for the patient. If so, follow local procedures. The actual shaving is often done in the surgical suite just before surgery, and the preparation done on the ward may be limited to cutting or clipping the hair close to the scalp.

(g) For surgery of the limbs (see figures 1-1 K, L, M, and N), the area includes the entire circumference. The extent of the prep varies depending upon the type of operation. As an example, for surgery of the hand, the prep would normally extend distally from the elbow. A manicure or pedicure is also necessary. Fingernails or toenails must be clipped short, cleaned, and scrubbed.

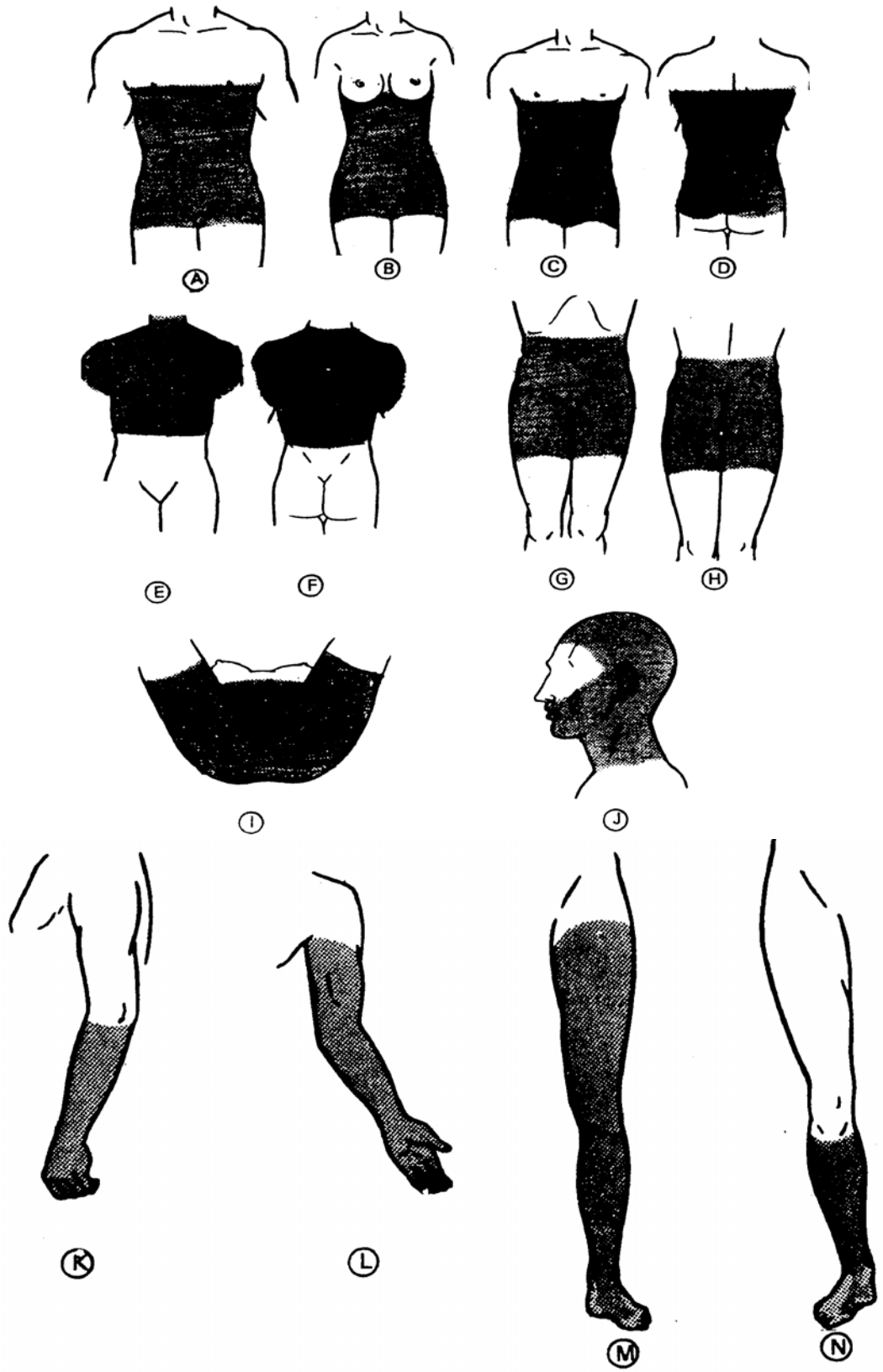


Figure 1-1. Skin areas to be prepared for surgery.
(Shaded areas are those to be shaved.)

(2) Other information. Local policy should also set forth instructions for performing surgical preparation of the skin when the procedure differs in some respect from that given below. For a discussion of principles and general considerations for preps in special situations, see paragraph 1-11.

d. **The Prep Tray.** Dependent upon local SOP and the type of equipment used, it may be necessary to assemble a prep tray. Before beginning a prep, the specialist should check the prep tray for completeness. It is embarrassing for the specialist to start a prep and discover that some of the equipment is missing. Worse, the patient tends to lose confidence in the specialist when such incidents occur, thus causing the patient-specialist relationship to suffer. As the specialist checks the tray, he should think briefly of the purpose of each article so that he will not overlook needed items. The equipment, if complete, is as follows:

(1) One tray--needed to hold and carry equipment.

(2) Two razors--one is to be soaked while the other is being used (although this is not a sterile procedure, the razors should be cleaned and soaked after each usage).

(3) A container and disinfectant--needed to soak the razors.

(4) A new blade--for each patient; sometimes more than one blade per patient is required.

(5) Antibacterial surgical detergent as prescribed--needed to wash and cleanse the area to be prepared.

(6) Two basins--one basin for the detergent, and the other basin for water.

(7) Cotton-tipped applicators--three or four are needed to clean skin indentations.

(8) Acetone--needed to remove adhesive tape marks, if they are present. (Try to avoid using ether for this purpose. It is irritating to the tissues.)

(9) Gauze fluffs--needed for washing and rinsing the skin.

(10) Adhesive tape--for picking up loose hair. Adhesive tape should be wrapped around used razor blades before disposing of the blades.

(11) Tissue--for wiping the razor.

(12) Scissors--for clipping long or excessive hair.

(13) A treatment sheet with cover--to protect the patient and the bed.

(14) Hand towels--to cover the tray and dry the patient.

(15) Newspaper (or other paper)--for disposal of used razor blades and waste.

(16) Orangewood sticks.

(17) Fingernail and toenail clippers--as required.

e. **Procedure.**

(1) Take the tray to the area where the prep will be done. Some hospitals have the ambulatory patients come to the OR suite; in other hospitals, the specialist does the prep on the ward. However, principles of cleansing the area and the technique for doing it remain the same. In the following discussion, it is assumed that a bed patient is to be prepped on the ward.

(2) Obtain a gooseneck lamp; one is usually available in each ward. (Note that this is the only item of ward equipment used, and it is an absolute necessity. When a prep is done without a good light, the OR light invariably shows hair that has been missed.)

(3) Locate and identify the patient. Tell the patient <u>what</u> is to be done and <u>why</u>. Screen the patient for privacy. Adjust the lamp so the light will shine directly on the area to be prepared.

(4) Put water into both of the solution basins, and add detergent to one.

(5) Place the treatment sheet in to protect the patient and his bed.

(6) Turn on the lamp and look carefully at the patient's skin before beginning the prep. If he has a rash, pimples, cuts, or other abnormal condition in the area to be prepped or if he has evidence of infestation with parasites anywhere on his body, report the finding to the surgeon. He will make the decision either to go ahead with the prep or to postpone surgery.

(7) Remove adhesive tape marks from the patient's skin (if any are present) with acetone.

NOTE: Acetone will neutralize the residual antiseptic properties of surgical soap such as hexachlorophene; therefore, use acetone first, when needed; then wash it off and apply surgical soap.

(8) Trim long or excessive hair in the area to be prepped with the scissors to avoid clogging the razor.

(9) When necessary, clean the umbilicus with cotton-tipped applicators and antibacterial detergent. For operations involving the hands and feet, trim and clean the nails, using scissors, orangewood stick, and fingernail and toenail clippers as necessary.

(10) Wash the area to be prepped thoroughly with the antibacterial detergent and discard the gauze fluffs as they are used (use newspaper for this; never put used fluffs back into the basins).

(11) Using your fingers, apply tension on the skin in the opposite direction in which you shave (see figure 1-2 B). When no tension is applied, the hairs are difficult to cut (see figure 1-2 A); however, when tension is applied (see figure 1-2 B) the skin is taut and the hair stands out prominently.

(12) With the blade of the razor held at a 15-degree angle to the skin and using short strokes, shave in the direction of the hair growth. Clean the razor frequently. Figure 1-3 illustrates a disposable razor. Conventional safety razors can also be used.

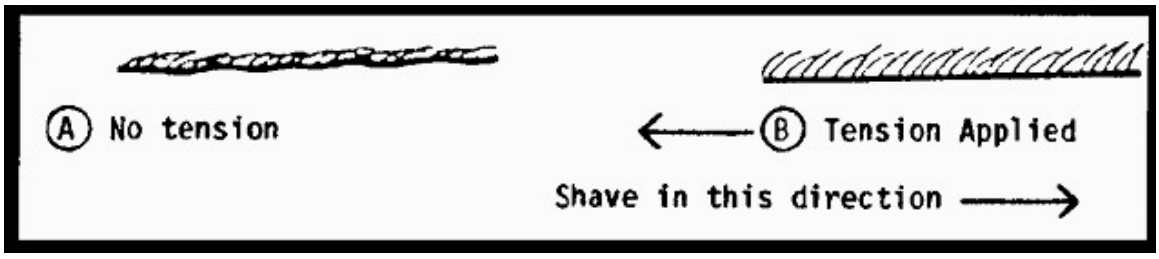


Figure 1-2. Applying tension on skin to raise hair.

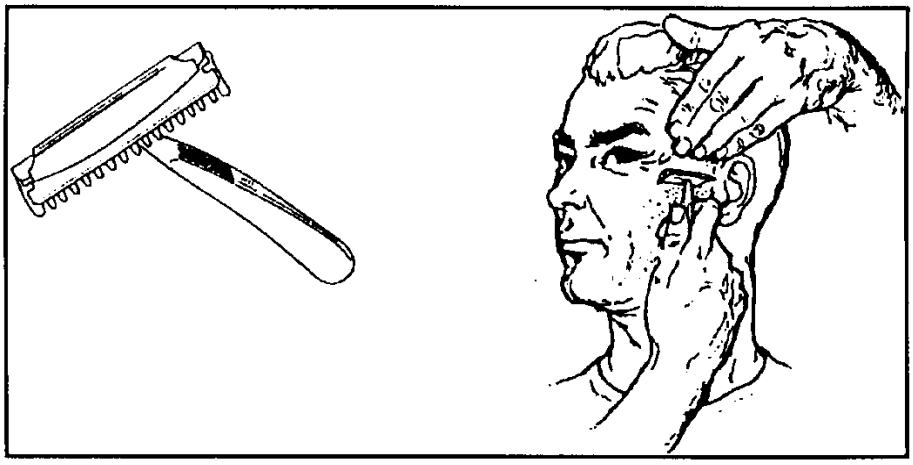


Figure 1-3. Shaving the area.

(13) Rinse the area with wet gauze fluffs and blot dry.

(14) Inspect the area thoroughly. Move the light around and examine the area from different angles.

(15) Pick up any loose hair on the patient by holding a piece of adhesive tape taut and gently applying the sticky side to the shaved area. When the loose hair has been removed, shave off any remaining hair.

(16) If the patient is able, he should shower and shampoo.

(17) Brush any loose hair from the patient's bed and remake the bed or tighten the sheets.

(18) If additional patients are to be prepped on the same ward, move the lamp to the next patient's bedside; if no other patient is to be prepped on the ward, return the lamp to its place of storage.

(19) Take the prep tray to the ward utility room and clean it before prepping another patient. Discard the newspaper containing waste and used razor blades; wash the razor, scissors, and the solution basin; remove the second razor from the disinfectant solution and put the razor and the scissors just used into the solution. (Since the scissors are not always needed, one pair is usually enough.)

f. **Resetting the Tray.** When all of the assigned preps are completed, the specialist returns the tray to the appropriate place in the OR suite and resets it, as follows:

(1) Dismantle the tray.

(2) Wash and autoclave the razors, solution basins, disinfectant container, tray, and scissors.

(3) Reassemble the tray and restock it with items set forth in paragraph d above.

g. **Disposable Equipment.** The ideal type of equipment is disposable. These prepackaged sets contain all of the basic equipment needed to prepare a patient; and upon completion of the procedure, the equipment is discarded, and the specialist thoroughly washes his hands. Hence, the possibility of transferring microorganisms from one patient to the next is significantly reduced. (Figure 1-3 illustrates a disposable razor.)

h. **Individually Packaged Preparation Sets.** The use of individually packaged "prep" sets of reusable basic equipment lends itself to a high degree of patient safety from cross-contamination, inasmuch as used equipment is "isolated" from fresh and

undergoes thorough decontamination prior to reassembly and reuse. Upon completion of the procedure, the specialist discards the fluff, tape, razor blade, and so forth, and places the reusable items in a predetermined area away from the fresh supplies. He washes his hands thoroughly and completely assembles the next setup prior to contact with the next patient.

i. **Other Preparation of the Patient for Surgery.** With completion of the above tasks, the specialist concludes his preoperative preparation of the patient for surgery. Numerous other measures done in the patient's preparation for operation are performed by the ward personnel.

1-11. PREPS IN SPECIAL SITUATIONS

a. **Prep of a Painful Area.** Such preps are usually individualized, the surgeon ordering whatever special measures he determines to be necessary. Local policy should be checked, however, as it may set forth procedures to be followed in certain cases or for some surgeons. The surgeon may order that a narcotic be given just before the prep is done or, depending upon the patient's condition and the nature and size of the painful area, he may order that the patient be anesthetized for the prep to be done. If anesthesia is given for the prep, surgery may be done as soon as the remainder of the preparation for surgery is done. Thus, the necessity for giving the patient anesthetic twice is avoided. The surgeon or one of his assistants may elect to do the prep; in this case, the specialist assembles the necessary equipment and assists as directed.

b. **Preps for Emergency Surgery.** In addition to the prep just discussed which may be done in a designated part of the OR suite (paragraph a above), another prep that is frequently done in the OR suite is that for the emergency surgical patient who is sent directly to the surgical suite upon admission to the hospital. The shaving and other preparation has been previously discussed (see paras 9 and 10). Whenever any prep is done in the OR suite, it should be done in a room other than that in which surgery is performed because it is important that the OR be kept free from hair.

c. **Prep with Depilatory Cream.** In some situations, a depilatory cream may be used to remove the hair. This is a chemical substance which, when spread on the skin surface, effects the removal of hair. It is used according to printed instructions on the container.

d. **Preps of Infected Patients.** Preparation of a patient with a known or suspected infection or communicable disease should follow all other "preps" to prevent contamination with a known pathogenic microorganism. The OR SOP should include care of equipment in this situation, and the hospital SOP will outline isolation techniques to be used for communicable diseases.

1-12. IMMEDIATE PREOPERATIVE SKIN PREPARATION

The final preoperative skin preparation (scrub prep) given the patient is done after the patient has been placed on the OR table (or in a chair) in the desired position and just before the sterile drapes are placed over him. This procedure is done by the surgeon or his medical officer assistant, assisted by the OR specialist. Aseptic technique is used and virtually the same large area as that outlined by the shave prep is given the scrub prep.

a. **Equipment.** The sterile items needed are provided by the circulator and are arranged by the scrub. The scrub may set up the materials on a small sterile table so the medical officer (surgeon or his assistant) doing the prep can obtain the needed items from the table himself, or the specialist may hand the items to the medical officer from the instrument (back) table. The following items are included for the prep:

(1) Four hand towels--one to dry hands, two to cover the patient's sheet at the distal and proximal edges of the operative field, and one to blot dry area.

(2) Two small basins for solutions.

(3) Soap or antibacterial detergent and an antiseptic solution.

(4) Sterile physiological saline or sterile distilled water.

(5) Textured gauze sponges.

(6) Two cotton-tipped applicators.

(7) One pair of sterile rubber gloves.

(8) Two Chux ® (disposable bed pads).

(9) Two sponge forceps.

b. **Procedure.**

(1) All team members follow aseptic technique in preparing the patient.

(2) If an open stoma (colostomy or other) is present, the circulator seals it off using adhesive strips, strips of cellophane tape, or an adhesive drape of appropriate size.

(3) The medical officer who is to perform the procedure scrubs his hands and arms. He dries his hands and arms and puts on the sterile gloves.

(4) The medical officer opens a towel and places it across the patient at the lower margin of the skin area to be prepared, then places another towel across the upper margin of the area to be prepared. In addition to serving as markers for the preparation, the sterile towels also protect the medical officer's hands and arms from the unsterile linen and the unshaved areas of the patient's skin.

(5) If the scrub hands the needed items to the medical officer, he must not allow his gloved hands or gown to come in contact with unsterile items or with any part of the medical officer's body, except for the medical officer's gloved hands. Objects that come in contact with the skin are unsterile because the skin is not sterile.

(6) The medical officer prepares flat surfaces by using textured gauze sponges saturated with a detergent or soap, manipulating the sponges with a circular motion while applying light pressure. He begins at the center of the proposed site and works toward the periphery. He uses a number of sponges wet in the soap or detergent because a used sponge is never brought back to a washed area. Crevices and indentations are cleaned using cotton-tipped applicators.

(7) The Chux ®, strategically placed, should absorb the moisture as it spills off the patient.

(8) When he has completed the scrub, the medical officer wipes the lather off with a sterile towel. (Time for the scrub, usually 10 minutes, is established by local SOP.) He "paints" the area with sponges wet in the antiseptic solution.

(9) The specialist removes the towels and Chux ®, being careful not to contaminate the prepared area.

c. **Special Procedure for Traumatic Injury to Limb.** In rendering an open traumatic limb injury surgically clean, there are two facets of contamination to be considered. In contrast to the routine surgical incision made with sterile instruments through surgically clean skin, the tissues in an open traumatic injury are contaminated, and additionally, are frequently damaged, providing lowered natural body defenses against infection. Secondly, because of the injury, there are often foreign bodies embedded in the tissue surfaces that carry microorganisms.

(1) In order to achieve an adequately prepared area, a more brisk scrub will usually be done, and the area irrigated with large amounts of solution. In addition to the basic sterile "prep" set, extra fluffs, a scrub brush, an asepto syringe, and irrigating solution are needed. Strategic placement of a large rubber sheet and kick bucket will prevent wetting of the patient and operating table, thereby allowing for moisture-free drapes.

(2) In order to prepare the entire circumference, the limb should be suspended for the "prep." Additionally, if there is bone damage, traction will have to be exerted throughout the time that the limb is suspended. Usually, this is best accomplished by an assistant OR specialist and must be maintained throughout the "prep" and part of the draping procedure.

Section III. SURGICAL POSITIONS

1-13. INTRODUCTION

a. **General.** The positioning of the patient for surgery is one of the most important nonsterile procedures in which the OR specialist assists because placement of the patient in the proper position safeguards the patient and affords him comfort while enabling the medical officer and the anesthetist to work effectively.

b. **Responsibility for Ordering the Patient's Position.** The choice of position is made by the surgeon, with minor adjustments, if necessary, for the type of anesthesia and its administration. The responsibility for positioning the patient rests with the anesthetist; however, since he is usually busy with the details of the anesthetic, he normally delegates this responsibility to the specialist under his supervision. Important considerations in positioning the patient include the following:

(1) The type of surgery scheduled. The operative area must be accessible and easy to keep sterile, and the position must be conducive to speed and efficiency of the surgeon.

(2) The type of anesthesia to be given. The patient's position must permit sufficient space for the necessary equipment.

(3) Protection of patient's vital processes. The patient's vital processes must not be impaired because of his position for surgery.

c. **Equipment for Positioning.** Before he can effectively position patients, the specialist must familiarize himself in detail with the mechanism of the operating table he will use, as well as the table attachments and the various supplies used. Following the acquisition of this basic knowledge, the specialist may gain skill and proficiency in the manipulation of the table and the placement of the attachments through practice.

(1) The operating table (see figure 1-4). Operating tables differ among hospitals and among rooms in the same hospital. However, most of the tables consist of a rectangular metal top that rests upon a hydraulic, wheeled base. The table is designed for placement of the patient in many different positions, while enabling his body structures and his vital processes to be safeguarded no matter what his surgical position is. Various features of the table that enable it to fulfill its functions are as follows:

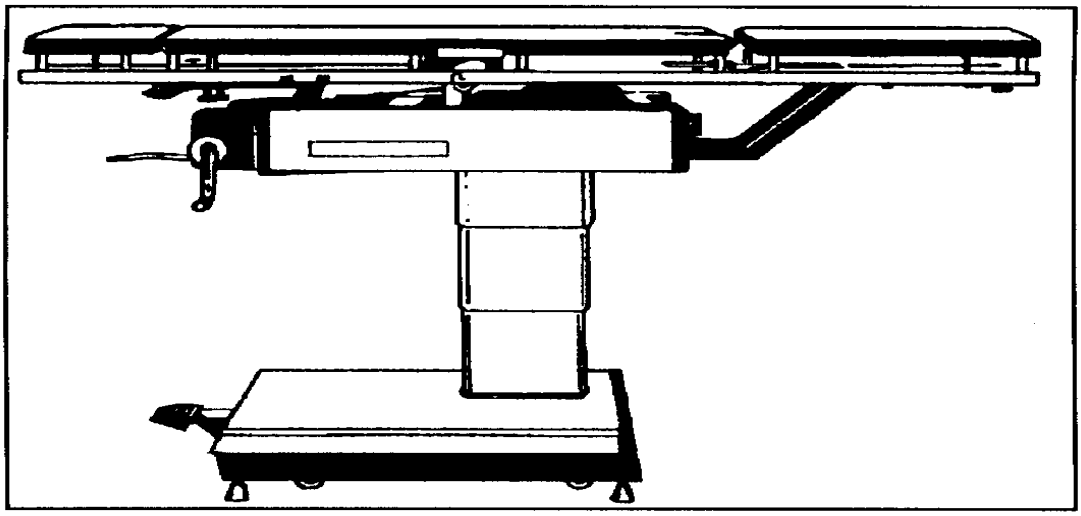


Figure 1-4. Operating table.

(a) The tabletop is divided into three or more hinged sections, each of which can be manipulated by means of a lever or a push button. The individual sections of the table can be flexed or extended so that the patient may be placed in any desired position. This procedure of adjusting the sections is often called "breaking" the table since the joints are referred to as "breaks."

(b) The table is equipped with a crossbar (body elevator) that can be used as an elevator for gallbladder or kidney operations. The bar is manipulated by a lever.

(c) There are metal clamps along the sides of the table for the insertion of various table attachments needed, such as the anesthetist's screen, the footboard, stirrups, shoulder braces, and body rests.

(d) Levers and lifts enable the entire table to be tilted from side to side or end to end and raised or lowered as desired. There is a brake locking the table base and a tiltometer that indicates the degree of tilt between vertical and horizontal.

(e) A mattress or pad is designed to fit the table, constructed in sections, and covered with conductive material for safety. This type of a covering also enables easy cleaning.

(f) The proper maintenance of the table is essential in ensuring that the table is always ready to serve its purpose. After each use, the operating table is cleansed with antiseptic solution. If blood or secretions are on the table, it is first washed with soap and water and then with an antiseptic solution. The metal table can be cleaned quickly and easily. In addition, the table should be checked daily for the stability and workability of all levers, brakes, and other mechanisms. Any faults should be reported immediately for repair.

(2) Table attachments. All attachments used to secure the patient in the desired position must be adequately padded to prevent trauma. Fresh padding is used for each patient.

(a) The anesthetist's screen is either a rectangular or a curved rod that keeps the sterile drapes off the patient's face and separates the sterile from the nonsterile field at the head of the table. Sterile drapes may be attached to intravenous (IV) standards on either side of the table rather than placed over the anesthetist's screen.

(b) The leg strap is made of leather or heavy canvas and is covered with conductive rubber. Sometimes called a restraint strap, it is used to restrain the patient's legs during induction of anesthesia and for placement in many positions. (Lithotomy, paragraph 1-19, is an exception.) The strap must be tight enough to prevent movement, yet not so tight that it will interfere with circulation.

(c) The patient's arms are usually restrained in the "lift sheet," a draw sheet that is placed across the operating table each time it is made up. The patient's arms should be tucked into the sheet before the anesthesia is started. Wristlets (leather cuffs) may also be used to secure the patient's hands and arms.

(d) An armboard of metal or wood may be used in several instances, and it is slipped under the mattress or attached directly to the table. Uses of an arm board include the following: support an arm when an intra-venous infusion is employed; support the arm on the unaffected side when the patient is in the lateral position; serve as an operating table when the site of operation is the arm or hand; hold the arm away from the field when the patient's arm at his side would be in the way of the operative area; or to support the arms when the patient is too obese for the table and hold both his body and his arms.

(e) Body rests are curved pieces of metal padded with foam rubber. These are placed in metal clamps on the sides of the table and slipped in from the table edge against the body to support and stabilize it in certain positions.

(f) Kidney rests are wider than body rests, but are also curved metal pieces with grooved notches at the base. They are slipped in from the side of the table along the kidney elevator (bar) to fit snugly against the side of the patient, supporting his body during kidney surgery.

(g) The metal footboard can be attached flat to increase the length of the table when necessary, or it may be placed at a 90-degree angle to the table and padded to support the feet in an upright position. The soles of the feet rest securely against it.

(h) Shoulder braces are of curved metal and are used to prevent the patient form slipping toward the head of the table while in certain surgical positions.

(i) Stirrups are metal posts; they are placed one on each side of the table at the lower (foot end) break and are used to support the legs and feet when the perineal area is the site of operation. The knees and lower legs may rest on padded metal supports or the feet may hang in canvas straps attached to an upright bar.

(j) The cerebellar headrest is a frame that supports the patient's head when he is in the prone position, and is used in spinal and posterior thoracic surgery. It is shaped to fit the face and has an opening for the nose and mouth.

(3) Additional necessary supplies.

(a) Pillows of various sizes are used to immobilize or to relieve pressure on a part.

(b) The lift sheet is used to secure the patient's hands and arms during the operative procedure.

(c) Sandbags in various sizes are used to immobilize a part.

(d) Adhesive tape of various widths and lengths is used when the patient is placed in certain positions to stabilize the body.

(e) Materials of foam rubber, sheet wadding, and cotton are used to pad attachments so that the patient will not be injured.

(f) Extra sheets and towels are used for stabilization in certain positions.

(4) Dressing the table. The table is routinely "dressed" or made up by covering the pad with a sheet doubled lengthwise and tucked in on the sides and ends. A lift sheet is placed across the center of the table; it is folded in quarters (fan folded). Folding it thus keeps the ends of the sheet from dangling down the side of the table, and enables the ends of the sheet to be moved without disturbing the rest of the lift sheet or the other linen on the table. The lift sheet facilitates moving and lifting the patient, and it is used to secure his arms at his sides. The leg-restraining strap is included in "dressing" the table.

d. **Principles Influencing Positioning.** The principles discussed below govern proper positioning. The specialist should follow the principles every time he positions a patient. The observation of these principles will ensure maximum safety and comfort for the patient.

(1) The patient should be told why he is being restrained, if he is awake.

(2) Unnecessary exposure of the patient should be avoided.

(3) The wheels of the operating table and the litter (or the bed) are always to be locked before the patient is moved.

(4) A sufficient number of personnel must be present to assist with positioning. At least two persons are required to place the patient in the surgical position desired.

(5) The patient is not to be touched or placed in position until the anesthetist indicates that it may be done.

(6) The patient's body alignment must be correctly maintained while he is being positioned.

(7) The persons who position the patient must be thoroughly familiar with the mechanics of the table and with its attachments.

(8) Personnel who position the patient must also know thoroughly the different types of positions and the surgical procedures in which they are used.

(9) The specialist should assemble all attachments and supplies before the patient arrives.

(10) When it is necessary to change the patient's position, the specialist should perform the procedure using movements that are slow, smooth, and gentle.

(11) All OR personnel must have a complete knowledge of the safety precautions that are mandatory in positioning.

e. **Precautions Mandatory in Positioning.**

(1) Respiration must not be impaired by interfering either with the free movement of the chest or with the airway. Therefore, anything that would constrict the chest or put pressure on it must be avoided. A change in position must be executed slowly, gently, and smoothly to safeguard the patient from respiratory embarrassment.

(2) Circulation must not be obstructed, either by pressure against the body parts or by too tight application of restraining straps. Changing the position of the patient too rapidly may also cause a circulatory depression (evidenced by a rapid fall in blood pressure). Free circulation helps prevent thrombus (blood clot), phlebitis (vein inflammation), and other postoperative circulatory disturbances. It also helps the flow of intravenous solution or a transfusion, if either is running and helps to maintain an even blood pressure.

(3) Nerve damage must be avoided; nerve injury and paralysis may result from either pressure on nerves or stretching of nerve tissue. To avoid such injury, the specialist should place attachments correctly, making sure that they are well padded. He should also exercise care that the patient's arms do not drop over the edge of the table, that they are not pressing against the edge of the table, and that they are not hyper-extended. Permanent paralysis of a part may occur because of prolonged pressure on the nerves.

EXAMPLE: Paralysis of the arm may result from incorrect placement of the shoulder braces.

(4) Muscles, tendons, and bones must be protected from injury. Excessive stress on these structures causes damage and must be avoided. Damage to these structures results in such postoperative complications as backache, foot-drop, and wrist drop.

f. **Positioning the Patient.**

(1) Equipment. The circulator should assemble the equipment needed. He should take all needed supplies into the room in preparation for the operation in addition to the equipment.

(2) Practice. The specialist should refer to the procedural manual and practice positioning until he has acquired skill and confidence. Until he is well practiced in placing patients in various positions, he should do practice trials of the position--preferably the evening before surgery--using a co-worker as the patient. The specialist (if in doubt about any step of the procedure) should consult his immediate superior at this time, not when the patient is anesthetized and ready for positioning,

(3) Complications. Positioning looks easy on demonstrations, but the actual situation is usually complicated by infusion tubes, drains, size of the patient, and his wound, or his anesthetized condition. Sufficient assistance must be available before any position is attempted. Positioning may also have to be changed during the course of surgery when the drapes, already in place, present a complication. In this situation, a thorough understanding of how the table operates is of primary importance.

g. **Commonly Used Positions.** Frequently used surgical positions are discussed in paragraphs 1-14 through 1-23. These positions may be modified to conform with local policy, or upon order of the surgeon. In the illustrations of positions, covers are left off the patient for clarity of illustration only. The specialist should avoid exposing a patient.

1-14. SUPINE POSITION (DORSAL RECUMBENT)

a. **Use.** This is the usual position (see figure 1-5) for administering general anesthesia and for doing most surgery of the abdomen such as laparotomy,

herniorrhaphy, and appendectomy. With slight modifications, it is also used for other types of surgery, such as surgery on the arms or legs.

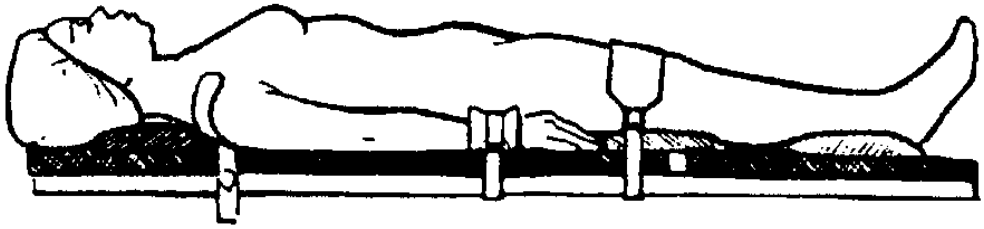


Figure 1-5. Supine (dorsal recumbent) position.

b. **Equipment Needed.**

(1) The anesthetist's screen.

(2) A sheet or bath towel. If support of the head is desired, a sheet or towel is folded and used--not a pillow, as it would be in the anesthetist's way.

c. **Procedure.**

(1) Look at the operating table to be sure that it is parallel to the floor.

(2) Place the patient flat on his back, his knees over the lower break of the table, feet slightly apart. The soles of the feet are supported by a foam rubber support or a padded footboard.

(3) Place the patient's arms and hands at his sides. His elbows should be slightly flexed and his fingers extended.

(4) Secure his hands and arms with the lift sheet.

(5) Place the leg strap at the distal third of his thighs, about two inches proximal to his knees. Fasten the leg strap tight enough to secure his legs, but not tight enough to constrict circulation. Check it by running a hand under it. If it is fastened too tightly to allow the hand to be run under it, loosen it enough to correct this. The leg strap is secured before anesthesia is begun.

(6) Remove the covering from the operative area and adjust the light. (This step is done when the anesthetist gives "OK," after patient is anesthetized.)

(7) Attach the anesthetist's screen.

(8) In order to prevent post-operative discomfort, flex the table slightly at both breaks or place a rolled towel or small pillow under the knees. This padding should be very soft, and should not make the strap too tight.

d. **Precautions.** Observe the precautions set forth in paragraph 1-13e.

e. **Modifications of the Supine Position.** The most usual modified supine position is one in which the table is flexed slightly at both breaks. Sometimes the knees are flexed with a small pillow instead. A number of other modified positions are mentioned in this paragraph. When the position of the table is changed with the patient on his back, special precautions are necessary to protect him.

(1) When the head is turned to one side or the other, it should be supported to keep the spine in alignment and secured in the desired position with a doughnut cushion, sandbag, or special headrest.

(2) Pressure over bony prominences where nerves and blood vessels run superficially must be avoided. The eyes must be carefully guarded against pressure, and they must be protected as drapes are placed to prevent corneal irritation from textiles, solutions, and other foreign bodies.

(3) For operations on the neck, the neck may be extended by placing a narrow support between the shoulder blades or by lowering the headpiece of the table. There should be no gaps in the support of the neck in this position. A special screen that protects the face may be used in thyroid surgery.

(4) For anterolateral incisions and for surgery on the shoulder or the chest, the patient's affected side may be elevated on rolls or pads. To prevent twisting of the spine, the full length of the body needs support that will keep the hips and shoulders in a plane. Body supports or straps in appropriate locations maintain the position and prevent rolling without interfering with the surgical approach.

(5) An arm-board may be used to support the arm on the affected side. In some cases, both arms are supported on arm-boards. In a few cases, the arm may be bandaged to the ether screen, using specific precautions against nerve and circulatory disturbances. In many procedures, one arm is usually extended on an arm-board to administer intravenous therapy. One or both arms may be extended in radical mastectomy and other surgery on the upper extremity and chest regions.

(6) The arm-board is padded to protect the skin and superficial tissues from pressure. The arm is extended at an angle less than 90 degrees to the table and level with the table. The arm-board is of the type that locks into position on the table to prevent inadvertent angle changes. Hyperabduction at the shoulder may cause both vascular and neural damage. Venous thrombosis may result when superficial veins are compressed by supports or straps or by the weight of body structures. The subclavian or axillary arteries may be occluded in abduction.

1-15. TRENDELENBURG POSITION

a. **Use.** The Trendelenburg position (see figure 1-6) is used for operations on the bladder, prostate gland, colon, female reproductive system, or for any operation in which it is desirable to tilt the abdominal viscera away from the pelvic area for better exposure.

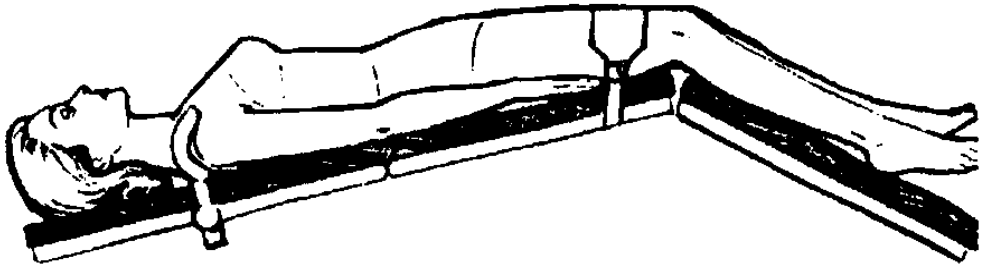


Figure 1-6. Trendelenburg position. Note that the knees are over the lower break in the table and shoulder braces are in place.

b. **Equipment Needed.**

(1) Shoulder braces.

(2) Padding, made of sponge rubber or of folded hand towels.

c. **Procedure.**

(1) Place the patient in the supine (dorsal recumbent) position and adjust the mattress so that his knee joints are directly over the lower break. The knees must bend where the table breaks to prevent pressure on blood vessels and nerves in the popliteal region, avoiding complications of phlebitis or paralysis of the leg. Secure patient's arms and legs.

(2) Attach well-padded shoulder braces to the table. Check to see that the braces are the same distance from the head of the table.

(3) Adjust braces so that they are on the outer part (bony joint) of the shoulders rather than against the neck. Braces should be adjusted one-half inch from shoulders to prevent excessive pressure when the head of the table is lowered.

(4) Flex the table at the knees, dropping the leg portion usually to an angle of 30 to 40 degrees.

(5) Tilt the entire table, the head low, to the angle desired by the surgeon, usually 30 to 40 degrees. The head should be lower than the knees.

d. **Precautions.**

(1) The nerve supply to the upper extremities comes from the spinal cord, gathers at the brachial plexus and emerges under the muscles in front at the root of the neck, where the neck and shoulder join. It is very important to protect these nerves when using the Trendelenburg position. This is done by using adequate padding on the shoulder braces, and by placing the braces at the outer aspect of the shoulders over the acromion and spinous process of the scapula.

(2) Careful positioning of the knees over the break is needed to prevent pressure in the popliteal space and safeguard the perineal nerve. Breaking the table at the knees takes some of the body weight off the shoulder braces and reduces pressure there. The legs are straightened before the patient is returned to a horizontal position.

(3) While this is mainly the anesthetist's concern, you should also know that this position may result in respiratory distress.

e. **Modification of the Position.** The Trendelenburg position is often mistakenly confused with shock position (extreme Trendelenburg position). The two are the same, except that in shock position, the table is straight (unbroken) at the knees so that the feet are higher than the head.

1-16. REVERSE TRENDELENBURG POSITION

a. **Use.** The reverse Trendelenburg position (see figure 1-7) may be used for surgery on the neck, such as thyroidectomy, and for certain abdominal surgery, such as liver or gallbladder operations.

b. **Equipment Needed.**

(1) Two small pillows or two folded sheets.

(2) Footboard, padded.

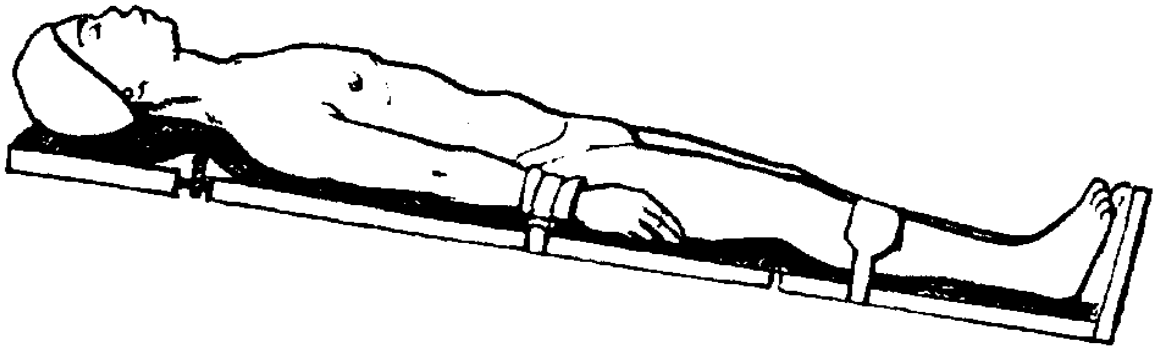


Figure 1-7. Reverse Trendelenburg position.

c. **Procedure.**

(1) Place the patient flat on his back. Adjust the mattress so that his shoulders are at the upper break of the table. If surgery is in the neck area, place a small pillow or a folded sheet transversely under the neck and shoulders, as shown in figure 1-7.

(2) Attach the padded footboard at a 90-degree angle to the table and adjust it so that the soles of the feet are resting against it. Place padding under the legs (see figure 1-7) to take pressure off the heels.

(3) Secure the arms and legs.

(4) Tilt the table, foot forward, to the desired angle.

d. **Elevator Bridge.** Some surgeons make use of the elevator bridge of the operating table to expose the gallbladder. When this is anticipated, the patient must be positioned with the costal margin at the level of the elevator. If an elevator is lacking, the table may be flexed at this level, or a pad may be inserted to achieve the desired position.

1-17. LATERAL KIDNEY POSITION

a. **Use.** The lateral kidney position (see figure 1-8) is used for surgery on the kidney or the proximal third of the ureter.

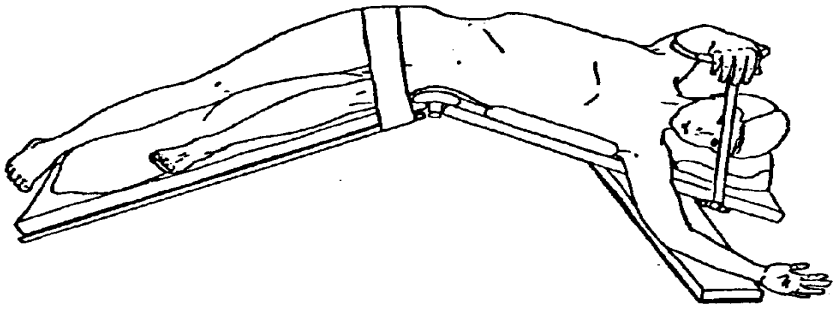


Figure 1-8. Right kidney position. Note the kidney strap across the hips for stabilizing the body and raised kidney elevator for hyperextending operative areas.

b. **Equipment Needed**.

(1) One or two large, soft pillows.

(2) Strap.

(3) Armboard, well padded.

(4) Short kidney rest.

(5) Long kidney rest.

(6) Foam rubber cushion.

c. **Procedure.** The patient is in the dorsal recumbent position until he is anesthetized. When the patient is ready for positioning, the circulator and his "unsterile" assistants are to proceed as follows:

(1) Turn the patient onto his unaffected side and bring his back near the edge of the table. Then wait until the anesthetist has checked the patient's blood pressure before continuing with (2) below.

(2) Manipulate the mattress as necessary until the patient's kidney area (the area between the crest of the ilium and the first rib cephalad from the iliac crest) is over the body elevator (crossbar, para 1-13c(1)(b)) of the table.

(3) Flex the (lower) leg on the unaffected side at the knee, extend the (upper) leg on the affected side and place a pillow lengthwise between the legs. Also, place padding under the leg in contact with the table at the sites of bony prominences (hip, knee, and ankle).

(4) Place a restraining belt or adhesive strap across the hips and chest to stabilize the body. Check the belt or strap for tightness by running your hand under it. Your hand should run smoothly under the belt or strap. Adjust as necessary.

(5) Position the arms by bringing them to the front of the patient. Flex the elbows slightly and place the arms on a well-padded double arm-board or Mayo stand. The arm of the unaffected side is usually used for intravenous infusion or transfusion.

(6) A well-padded short kidney rest is placed at the patient's back.

(7) Place a long kidney rest, well padded, in front.

(8) Adjust the body elevator only upon the order of the anesthetist or the surgeon. When manipulating the bar, move it slowly, because too sudden a change may result in complications in the patient's respiration or circulation.

(9) Adjust the table to make the operative area horizontal.

1-18. LATERAL CHEST POSITION

a. **Use.** The lateral chest position (see figure 1-9) is used for thoracoplasty, pneumonectomy, and lobectomy.

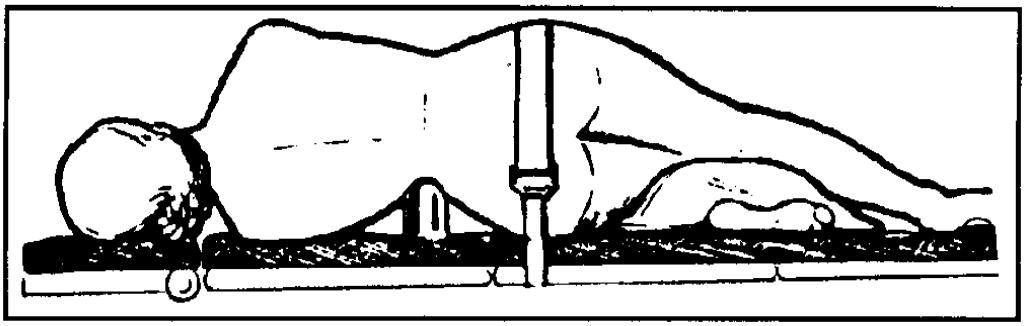


Figure 1-9. Right lateral position. Note the strap across the hips and body rest for stabilizing the body.

b. **Equipment Needed.**

(1) Single armboard.

(2) Small, hard pillow/form rubber cushion.

(3) Large, soft pillow.

(4) Two chest rests/sandbags.

(5) One or two kidney straps.

(6) Three inch adhesive tape.

c. **Procedure.**

(1) Place the patient on his unaffected side with his back near the edge of the table. This requires two people: the anesthetist managing the head and shoulders, and the assistant moving the hips.

(2) Place the upper leg straight with the patient's body, and flex the leg on the lower side. Place a pillow lengthwise between the legs.

(3) Place a folded sheet or a small hard pillow under the patient so that it is immediately beneath the operative area (see figure 1-9). This relieves some of the pressure on the arm on the unaffected side and permits the free flow of any replacement fluids infused through the vessels of this arm.

(4) Place a chest rest near the lumbar area, and another at the level of the axilla.

(5) Bring the patient's arms and hands in front of him near his face and secure them. Secure the arm on the unaffected side to a padded arm board and the other arm rests on a pad as it hangs over the side of the table. This draws the scapula away from the operative area.

(6) A pad or small pillow is used to align the head and neck.

(7) Secure a strap over the hips. A second strap is sometimes used to stabilize the shoulder.

(8) Tilt the table slightly, with the patient's head towards the floor if the patient needs postural drainage during surgery. If the patient's head is to be lowered, secure the mattress to the table to prevent it from slipping.

1-19. LITHOTOMY POSITION

a. **Use.** The lithotomy (see figure 1-10) position is used for surgery in the perineal area, such as drainage of rectal abscesses and perineal prostatectomies, and for gynecological surgery such as vaginal hysterectomy.

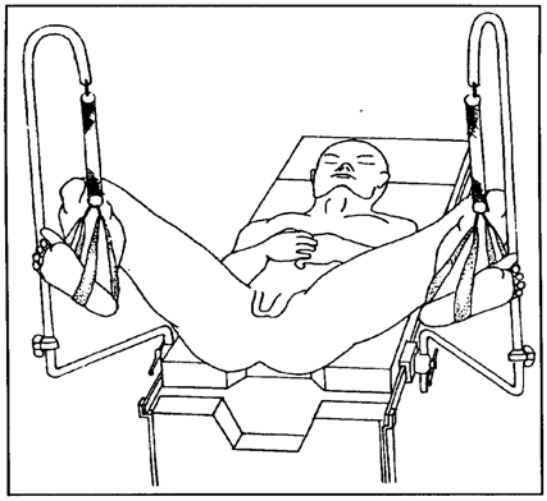


Figure 1-10. Lithotomy position. Patient is on his back with the foot section of the table lowered to a right angle with the body of the table. Knees are flexed and the legs are on the outside of the metal posts with the feet supported by canvas straps. The buttocks are even with the table edge.

b. **Equipment Needed**.

(1) A double-ringed basin stand, or an extra Mayo stand.

(2) One pillow.

(3) A rubber sheet, a Kelly pad, or a disposable paper mat, and a kick bucket.

(4) Extra folded sheet or bath towel.

(5) Folded hand towels for padding the stirrups.

(6) Stirrups-upright bars with canvas straps.

c. **Preliminary Preparation of the Table.** The specialist makes some adjustment and preparation of the table before positioning the patient.

(1) Pad a double-ringed basin stand or an extra Mayo stand with a pillow and place it at the foot of the table. The stand is used as a temporary table extension. If the table has a removable headrest, the headrest can be used as the temporary table extension.

(2) Cover the table from the knee break to the foot; first with a rubber sheet or a Kelly pad, and then with an extra folded sheet or bath towel.

d. **Procedure.** For the administration of anesthesia, the patient is placed in the supine position with buttocks at the edge of the knee break. In this position, the patient's legs will of course extend beyond the end of the table, but they will be supported by the extra basin stand, Mayo stand, or headrest. When the patient is anesthetized, the specialist and an "unsterile" assistant place the patient in position as follows:

(1) Remove the leg restraint.

(2) Fold the patient's arms and hands either across his upper abdomen or across his chest. See paragraph 1-19e, Precautions.

(3) Make sure the two stirrups are level, and at the proper height. Each of the two "unsterile" team members takes a position on either side of the patient at the foot end of the table. Each team member grasps a patient's leg near the knee with the other hand. The team members then flex the patient's legs and simultaneously lift them and place them in the padded stirrups. It is important that both legs be lifted at the same time to prevent injury to the patient.

(4) Place the legs in the padded metal supports and secure the straps. To position the legs using canvas straps, bring the legs to the outside of the upright bars. Loop the strap once around the sole of the foot and once around the heel. Pad the bars with folded hand towels in the areas where they are touching the legs or where the legs may press against the bars.

(5) Remove the basin stand or Mayo stand, if used.

(6) Remove foot section of the table mattress and break and drop the foot of the table.

(7) Pull the stirrups forward to extend slightly beyond the foot end of the table. Viewed from the side, the legs should form a "Z" shape with the angle of the buttocks.

(8) Place the end of the Kelly pad (if one is used) in the kick bucket. This pad keeps the table dry under the patient during the surgical prep. The pad is removed after the prep and before the patient is draped.

e. **Precautions.** This unnatural posture is fraught with danger and discomfort for the patient, and these hazards increase as the position is exaggerated for radical surgery. Extreme flexion of the thighs impairs respiratory function by increasing intra-abdominal pressure. Gravity flow of blood from elevated legs causes blood to pool in the splanchnic region. Arms also require special care in lithotomy position. The hands should not extend along the sides, since they will reach below the break of the foot section of the table and be in danger of injury from manipulation of table parts. They may be folded loosely across the abdomen and supported by the folded gown or cover sheet, or one may be extended on an arm-board for infusion while the other is suspended from the anesthesia screen. Be sure they do not impede chest movement.

1-20. PRONE POSITION

a. **Use.** The prone (see figure 1-11) position is used for surgical procedures-major or minor-that are performed on the back, shoulders, neck, or back of the head. Placement of the patient in the prone position for minor surgery, using local anesthesia, differs in some respects with placement for general anesthesia.

b. **Prone Position for Local Anesthesia.**

(1) Equipment needed. This equipment is the necessary material to support the body in good alignment and to relieve pressure on blood vessels and nerves. Pillows, sheets, towels, and padded arm-boards are needed as indicated in paragraph (2).

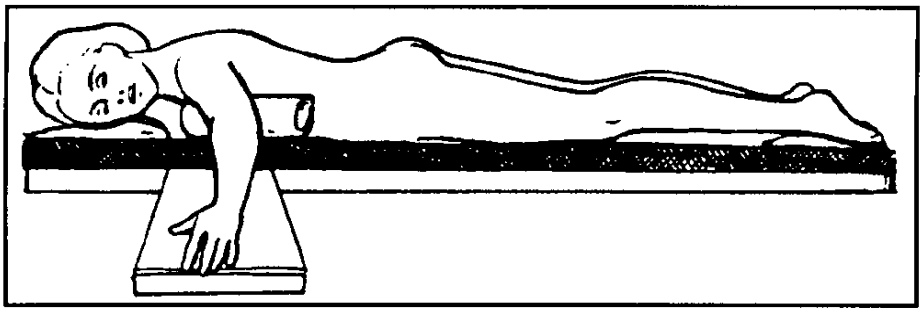


Figure 1-11. Prone position. The patient lies on his abdomen. Note shoulder rolls under axillae and sides of chest to raise body weight from the chest to facilitate respiration. The patient is anesthetized and the endotracheal tube inserted in dorsal position. He is then turned to prone.

(2) Procedure.

(a) Adjust the table so that it is flat and horizontal.

(b) Assist the patient in turning onto his abdomen, and have him turn his face to one side. Place a small pillow or ring cushion under his head to avoid pressure on his ear.

(c) Place a pillow under his thighs and hips.

(d) Place a pillow under his feet so that it extends nearly to the knees.

(e) Flex the arms at the elbows and place alongside the patient's head, on padded arm boards.

(f) Place a small pillow or a rolled sheet under each shoulder and down the sides of the chest, as shown. This prevents pressure on the chest and allows for free respiration.

(g) Secure the leg strap to the lower third of the thigh and check it for tightness.

c. **Prone Position for General Anesthesia (Extended Prone Position).** When the surgical procedure is to be done with the patient in prone position under general anesthesia, the cerebellar headrest is used to allow the anesthetist access to the patient's respiratory tract.

(1) Equipment needed. In addition to that set forth above, the following items are needed:

(a) A well-padded cerebellar headrest.

(b) Shoulder braces, if the patient is to be placed in a head-low position.

(2) Procedure. The patient is placed in the dorsal recumbent (supine) position for the administration of anesthesia. While the patient is being anesthetized, the specialist rolls two sheets so that they will extend from the patient's axilla to his iliac crests. Turning the patient onto his abdomen requires four persons plus the anesthetist, who manages the patient's head and any tubing in use. The procedure is as follows:

(a) Lift the patient's head slightly, remove the hinged headpiece, and attach the cerebellar headrest in its place.

(b) While the anesthetist manages the patient's head, two persons on each side of the patient turn him first on his side, and then onto his abdomen. At the same time, pull him toward the head of the table in order that his face and forehead will rest properly in the cerebellar headrest. Check to see that there is not pressure on the patient's eyes, nose, or mouth.

(c) Place pillows.

(d) Place the two rolled sheets, one on each side, from the patient's axilla to his iliac crest, thus raising his chest from the mattress and providing free respiration.

(e) Both arms are arranged on boards.

d. **Precautions.** These are as described previously (see para 1-13e).

1-21. JACKKNIFE (KRASKE) POSITION

a. **Use.** The jackknife (Kraske) (see figure 1-12) position is used for surgery on the coccyx, buttocks, or rectum, particularly when the patient has had spinal anesthesia and there is no objection to his being placed either face downward or head low.

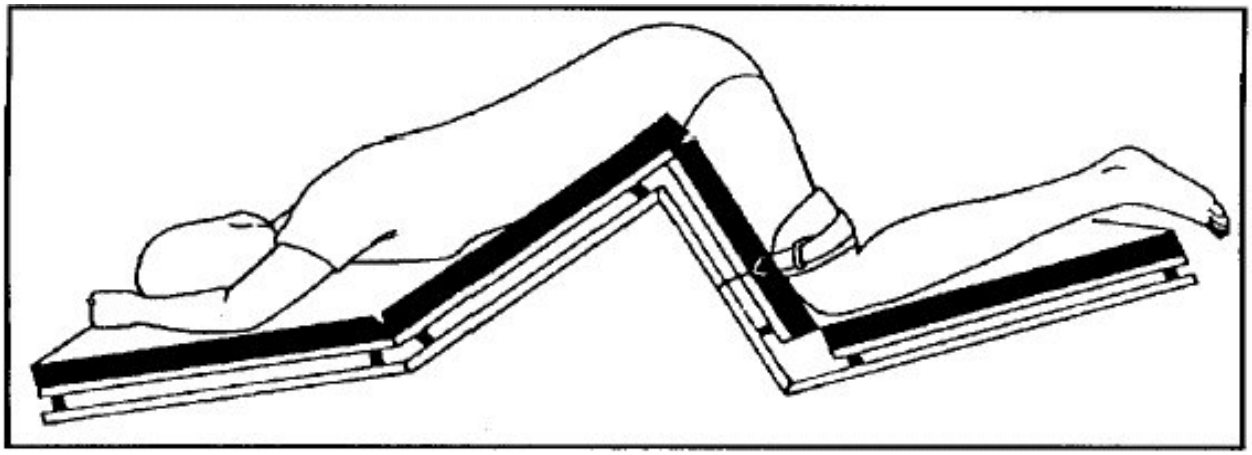


Figure 1-12. Kraske position. Note that the hips are over the table break, and the table is flexed at a 90-degree angle.

b. **Equipment Needed**.

(1) Pillows for support.

(2) Padded armboards.

(3) Adhesive straps.

(4) Body rolls.

c. **Procedure.** The patient is anesthetized in the appropriate position, depending upon the type of anesthesia used. When he is ready for positioning, the following steps are taken:

(1) Turn the patient on to his abdomen. (This is done by four persons plus the anesthetist as described in paragraph 1-20c(2).

(2) Place the patient's hips directly over the break of the table. A pillow may be placed under his hips (not shown in figure 1-12).

(3) Position the patient's head by turning it to one side. Place small pillow or a ring cushion under his head as discussed above. The feet may be allowed to hang over the foot end of the table to prevent pressure on the toes. Place a pillow or padding under the legs.

(4) Secure the leg strap and check it for tightness.

(5) Flex his arms and elbows, and place his arms on padded armboards or Mayo stands.

(6) Flex the table at the knee break to the angle desired by the surgeon. Tilt the table and the head floorward to the angle ordered. The patient's hips are thus placed higher than the rest of his body.

(7) Separate the buttocks by securing strips of adhesive tape from the patient to the side of the table. Before putting the tape on the patient, first paint the area where the tape is to be placed with tincture of benzoin. Use a sponge forceps and a 4 x 4 sponge. Be careful not to let the tincture of benzoin spill on the table or the floor. Let the tincture benzoin dry thoroughly before applying the tape. An application of tincture of benzoin ensures that the tape will remain firmly in place and will not be loosened, even during the prep. Patients who are hairy in the area where the tape is to be placed should have this area shaved before being brought into the OR.

d. **Precautions.** These are discussed above and in paragraph 1-13e.

1-22. SITTING POSITION

a. **Use.** Included in surgery for which the patient sits upright are various operations on the nose and throat, as well as some plastic surgical procedures. The sitting position (see figure 1-13) is described using the operating table as a chair.

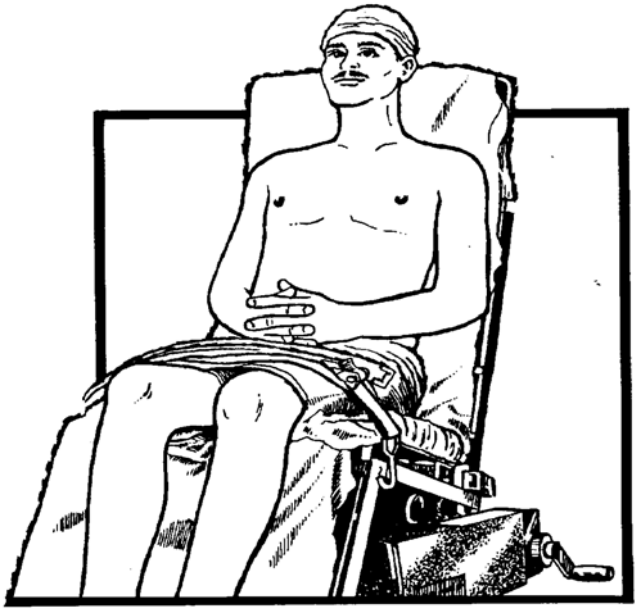


Figure 1-13. Sitting position.

b. **Equipment Needed.** Most of the items discussed below for the support of the patient are omitted from figure 1-13 for clarity of illustration. The equipment needed are one pillow, two sheets, shoulder straps, and a padded footboard.

c. **Procedure.**

(1) Attach the footboard at a 90-degree angle to the table.

(2) Secure adhesive straps across the mattress for stabilization.

(3) Secure ends of lift sheet under the mattress.

(4) Break the table into a sitting position.

(5) Pad the footboard with a folded sheet.

(6) Assist the patient onto the table.

(7) Adjust and secure the leg strap. Adjust the footboard so that the feet are resting securely on it.

(8) Place a sheet around the patient so that it reaches from the axilla to the iliac crest. Leave the arms free. Tie the sheet behind the table, using a square knot.

(9) Place a pillow in the patient's lap to support his arms. The arms may then be restrained in the lift sheet.

1-23. POSITIONS FOR SPINAL ANESTHESIA

a. **Discussion.** The patient may be in either a lying or a sitting position for the administration of spinal anesthesia. The position used will depend upon the condition of the patient and the preference of the anesthetist.

b. **Lying Position** (see figure 1-14). Most subarachnoid blocks are given with the patient lying on his side.

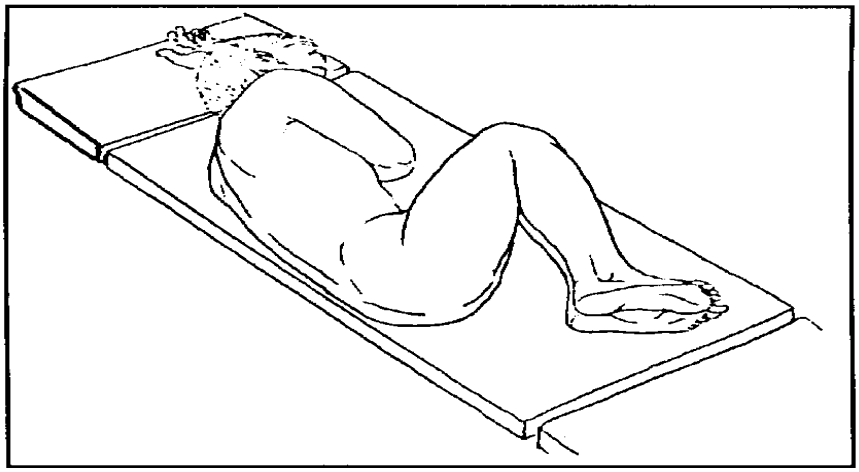


Figure 1-14. Lying position for spinal anesthesia. This is the Sims position and is often referred to as the curled lateral position and is useful in establishment of subarachnoid and epidural anesthesia. (From Martin, J.T., M.D.; Positioning in Anesthesia and Surgery, ed. 2, Toledo, Ohio, 1987, W. B. Saunders Company.)

(1) Principles. The two basic principles for the steps discussed are to get the spinous processes of the vertebral column parallel to the table and keep them in that position while the patient is well flexed in order to open the vertebral interspaces.

(2) Procedure.

(a) Adjust the table so that is flat and horizontal.

(b) Place the patient on his side with his back even with the edge of the table. Instruct the patient (if he is able to do so) to bring his knees up toward his chest, and to flex his head (chin on chest). Ask the patient to curl up, arching his back like an "angry" cat.

(c) Check to see that the patient's knees are together and that his shoulders are in alignment, one directly above the other, to facilitate the anesthetist's entering the needle into the vertebral interspace.

(d) Caution the patient not to move. Assist him in holding his position by placing one arm behind his neck and the other arm behind his knees.

(e) Do not place the patient in the desired surgical position after the anesthetic has been administered until instructed to do so by the anesthetist.

c. **Sitting Position** (see figure 1-15). Sometimes, the anesthetist has reason to believe that, due to the condition of the patient, he may have difficulty in performing the lumbar puncture satisfactorily with the patient lying down. Faced with this type of situation, the anesthetist may order that the specialist place the patient in a sitting position.

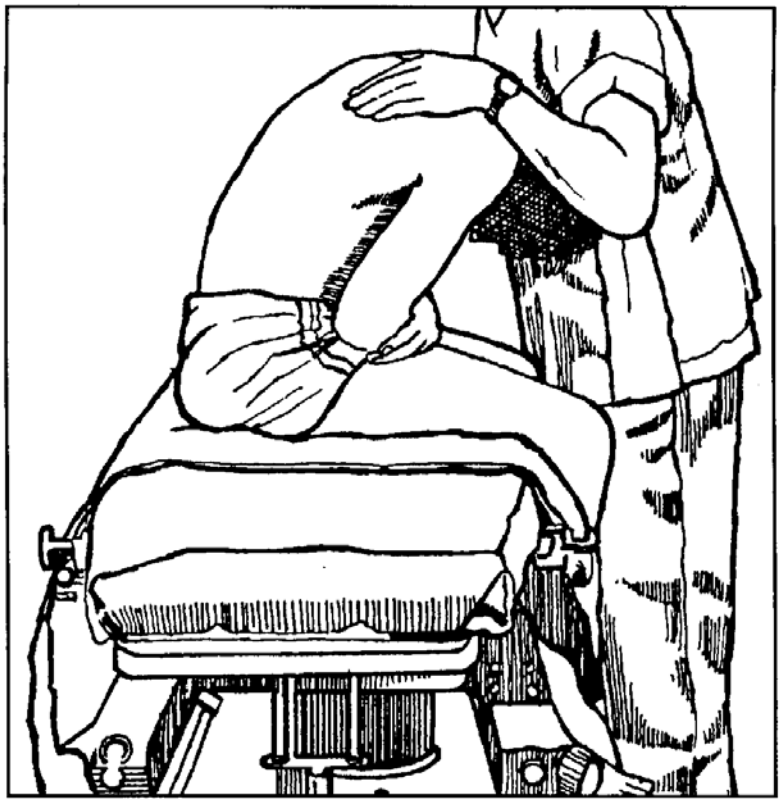


Figure 1-15. Sitting position for spinal anesthesia.

(1) Equipment needed. A stool for the patient to rest his feet upon is needed.

(2) Procedure.

(a) Place the patient in a sitting position with his legs over the side of the table. Put the stool under his feet.

(b) Instruct the patient to lean forward, his chin on his chest, and to arch his back as much as possible. Caution him not to move.

(c) While the lumbar puncture is being performed and the anesthetic is being administered, stay with the patient. Support the patient by holding his head and shoulder with one arm and his thigh with the other arm. Watch the patient closely for any unusual signs or symptoms such as paleness, weakness, and dizziness. Do not place the patient in the desired surgical position until the anesthetist orders it done.

Section IV. DRAPING THE PATIENT

1-24. INTRODUCTION

a. **General.** Draping is another of the precision routines performed in the OR. Surgical draping of the patient is the placing of sterile coverings on him so that only the operative site is exposed. Thus, the skin areas that have not been prepared for surgery are covered in order that they will not contaminate any sterile items. The sterility of drapes depends upon their remaining dry and undisturbed; therefore, the placing of drapes is the last procedure done prior to making the surgical incision. In addition to the patient, the furniture to be used within the immediate surgical area must be covered with sterile drapes to prevent contamination of the wound.

b. **Purpose.** The purpose of draping is to create a sterile field by means of the appropriate and careful placement of linen before surgery begins and to maintain the sterility of surfaces on which sterile instruments and gloved hands may be placed during the operation. These requirements presuppose that all drapes are well secured with towel clips (where necessary) according to the accepted procedure to prevent disarrangement and contamination, and that the nonsterile anesthetist and the area required for him are excluded from the sterile area by a drape-covered screen.

c. **Extent of Draping.**

(1) Thickness of drapes. One drape (two thicknesses of material) provides an acceptable cover for a sterile field under usual conditions. More than two thicknesses may be required, however, especially in those areas where either instruments or sponges are laid if there are possible sources of contamination, such as moisture, which may seep through to an unsterile surface beneath. Too many layers of drapes over a patient are detrimental to him because they cause him to perspire profusely. In addition, the excessive perspiration may soak through the drapes, thus contaminating them.

(2) Area draped. The sterile drapes must extend over the sides and ends of the tables to prevent contamination of either the sterile instruments or the gowns worn by members of the team.

d. **Responsibility for Draping.**

(1) Scrub. The scrub is responsible for providing an area large enough for all sterile supplies to be used. He stacks the drapes for the patient, prepares the operating table in the proper order of their use, and refolds towels as necessary for the case and handing these, with towel clips, to the surgeon. If the surgeon has no medical officer assistant for the case, the specialist helps him drape the patient.

(2) Surgeon. The surgeon is responsible for the draping of the patient. When the surgeon has scrubbed and put on gown and gloves, he places the towels (securing them with towel clips) outlining the incision area, after the skin has been prepped and has dried. This completed, the surgeon may choose to place the drapes himself with the help of his assistant or to supervise their placement by his assistants and the scrub.

e. **Types of Drape Material.**

(1) Synthetic and paper. Absorbent and nonabsorbent synthetic and paper disposable drapes are available in presterilized packages. The most popular ones are soft, lint-free, lightweight, compact, non-irritating and static free. They prevent heat retention by patients because of their lightness, yet they do not usually require reinforcement to prevent moisture seepage. The main disadvantage of synthetic drapes is that solvents, volatile (evaporating) liquids, and sharp instruments may easily penetrate the barrier and cause contamination. The high cost is largely offset by the elimination of laundering, folding, and sterilizing that is necessary for linen drapes.

(2) Impermeable plastic drapes. Impermeable (not permitting passage, especially of liquid) plastic sheeting in various types and sizes is available with an adherent coating. Since it adheres tightly to the skin, the initial skin incision is made through it; therefore, it may be used instead of the skin towels and clips, especially since it serves as an excellent barrier at the incisional site and the surrounding area. A Vi-drape is an example of an impermeable plastic drape. Impermeable plastic drapes are especially useful for draping irregular surfaces, such as neck and ear regions, or limbs and joints. This type of drape may also be used to isolate a contaminated area (such as the stoma of a colostomy) from the operative site. The plastic drape isolates the wound completely and prevents the contact of sterile materials with the patient's skin. When used, the plastic adherent drape is applied first, and the remaining drapes are placed in the usual manner.

(3) Linen. The linen drapes most frequently used include:

(a) Hand towels used to outline the incision area.

(b) Sheets (ordinary bed sheets) are fan folded to cover the sterile field or to extend the sterile area.

(c) Fenestrated sheets made in various sizes and with slits or windows of a size sufficient to accommodate the length of the proposed incision.

(d) Stockinette used as draping on limbs.

(e) Perineal sheets used with the patient in lithotomy position. They have leggings sewn on them to cover the legs.

f. **Basic Requirements for Drapes.** Drape material must be free from holes and free from worn or thin areas. A drape must be of sufficient thickness, and it must be fanfolded, so that it can be opened quickly and placed without contamination.

g. **Use of Packs.** The use of linen packs for various types of surgery (laparotomy, perineal, or orthopedic) saves time and effort as compared to opening individual packages of the many items needed. All articles in a linen pack should be stacked on the sterile table in the order of their use as a further timesaving device.

h. **Procedure for Draping.** Procedures for draping may vary somewhat among hospitals depending on the types and the amount of linens available, but the principles pertaining to the sterility and efficiency of the draping procedure remain the same. These principles are set forth below.

i. **Points to Remember.**

(1) Sufficient time must be allowed for draping. Drapes carelessly placed without prior thought or plan may mean contamination and further delay while the circulator procures and opens additional sterile items.

(2) The scrub should have room enough to step back and open a drape sheet without contacting other supplies or equipment.

(3) Drapes should be handled as little as possible.

(a) If there is any question as to whether or not a drape has been contaminated, discard it without further handling.

(b) If a large drape opens incorrectly, do not try to rectify the error by "switching ends." Discard it as contaminated and get another drape to replace it.

(c) Only the circulator may remove contaminated linen.

(4) Once the end of the drape falls, drops below table level, or touches the patient, it may not be handled further. To do so would contaminate the gloves of the "sterile" person.

(5) The folded edge of the drape is always placed toward the incision area.

(6) Sterile drapes should never be handed to another person across an unsterile area.

(7) A folded drape is carried to the operating table and opened there. The placement of large drapes requires two people.

(8) When drapes are being opened, they should be held above waist level, high enough to avoid touching the table, and away from the body, but they must not touch the light fixture.

(9) Drapes are laid on the operative field, never dragged over it.

(10) Once the drape is placed, it should not be moved. The only exception to this rule is that a drape may be pushed slightly away from the incision area; however, it must remain within the skin area that has been prepared using sterile technique. A drape may never be moved closer to the operative area.

(11) Drapes contaminated or incorrectly placed should be removed by the circulator from the operative area without contaminating the other drapes or the area.

(12) The initial drapes are placed on dry areas only, and the sterile field is kept as dry as possible during surgery. If drapes should become damp during surgery, additional sterile towels may be placed on the area, or a towel lined with sterile plastic may be used to drape the sterile area just below the incision.

(13) The points of a towel clip are contaminated after placement through a drape. If the towel clip is removed, it should be discarded to the circulator and a sterile drape placed over the area of removal.

(14) Linen for draping must be thoroughly dry when it is placed.

(15) "Sterile" team members should always protect gloved hands in a fold of the drape being placed.

(16) The circulator must move all buckets away from the OR table before draping of the patient begins. This enables the other members of the team to avoid stumbling over the buckets, and it prevents the buckets from being covered accidentally by the drapes.

j. **Draping for Operations.** Draping procedures for various operations, including methods, are discussed in paragraphs 1-25 through 1-27. After mastering the principles and methods of draping, the specialist should practice the arrangement and the placement of drapes until he has acquired skill in the performance of the procedures. In the following procedures, the scrub and the surgeon are the "sterile" team members in draping the patient.

1-25. LAPAROTOMY DRAPE

a. **Use.** Laparotomy drapes (see figures 1-16 A, B, C, D, and E) are used for operations on the abdomen or on the back.

b. **Procedures for Linen Drapes (Non-Disposable).**

(1) The scrub stacks the drapes on the back table in the order of use: laparotomy sheet on the bottom, one drape sheet, four towel clips, four hand towels refolded with a 4-inch cuff on one long side, plus two drape sheets.

(2) The surgeon and the scrub open the drape sheet carefully, holding it high, and place it from the knee area toward the bottom of the table.

(3) The second drape sheet is opened and placed with the smooth edge at the bottom (distal) edge of the incision site down toward the foot of the table and overlapping the first sheet.

(4) The scrub moves to the surgeon's side of the table and hands the drape towels, one at a time, to the surgeon--three towels with the cuff turned away from the surgeon and the last one with the cuff turned towards him (see figure 1-16 C).

(5) The surgeon places the first towel at the operative edge nearest him, the second at the lower edge of the operative site, the third at the upper edge, and the fourth on the side opposite him.

(6) When all of the towels are in place, the scrub hands the towel clips, one at a time. They are then placed by the surgeon.

(7) The final drape sheet is opened and placed above the incisional site (proximal edge) and over the anesthetist's screen.

(8) The "sterile" team members drape the laparotomy sheet by placing the opening over the operative area. The team members then open the lower fold over the patient’s feet and the upper fold over the anesthetist's screen. During the process of unfolding the sheet, each team member protects the gloved hand he is working with in a fold of the sheet and holds the sheet in place with his opposite hand in order that the opening will remain over the incision area (see figure 1-16 D).

(9) The "sterile" team members cover completely any armboard in use, as though a part of the table. If the armboard extends the edge of the laparotomy sheet, the team members place an additional drape over it. The surgeon may need towel clips to secure the two sheets at the overlap; or the circulator may grasp the sheet by its upper side as it hangs free below the patient's arm where it is unsterile. He pins the sheet to an IV standard to relieve its weight and to allow the anesthetist access to the arm (see figure 1-16 E).

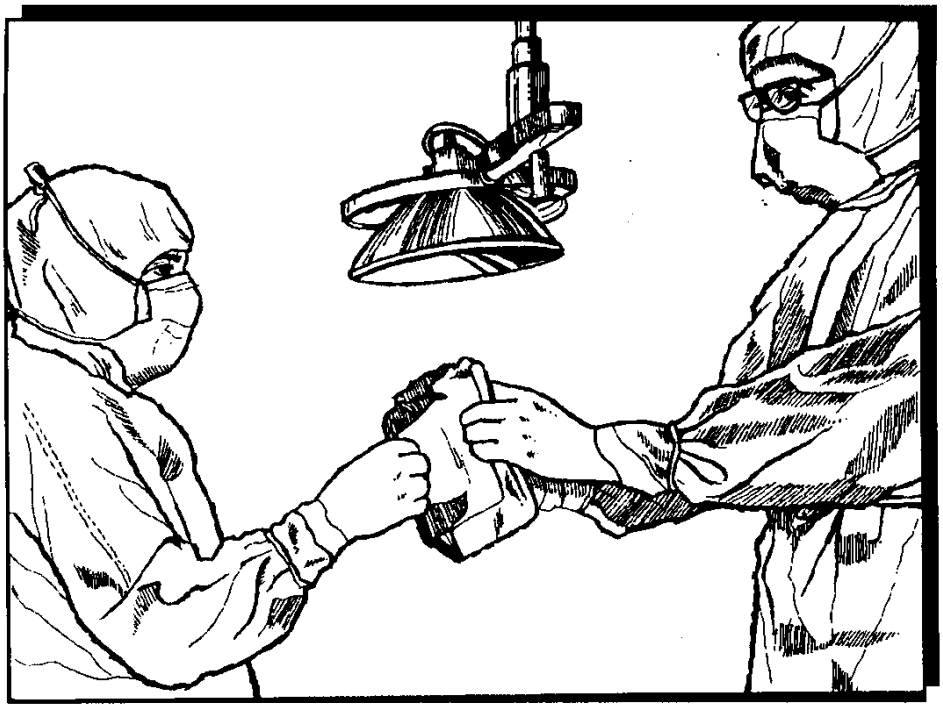


Figure 1-16 A. Laparotomy drape (continued).

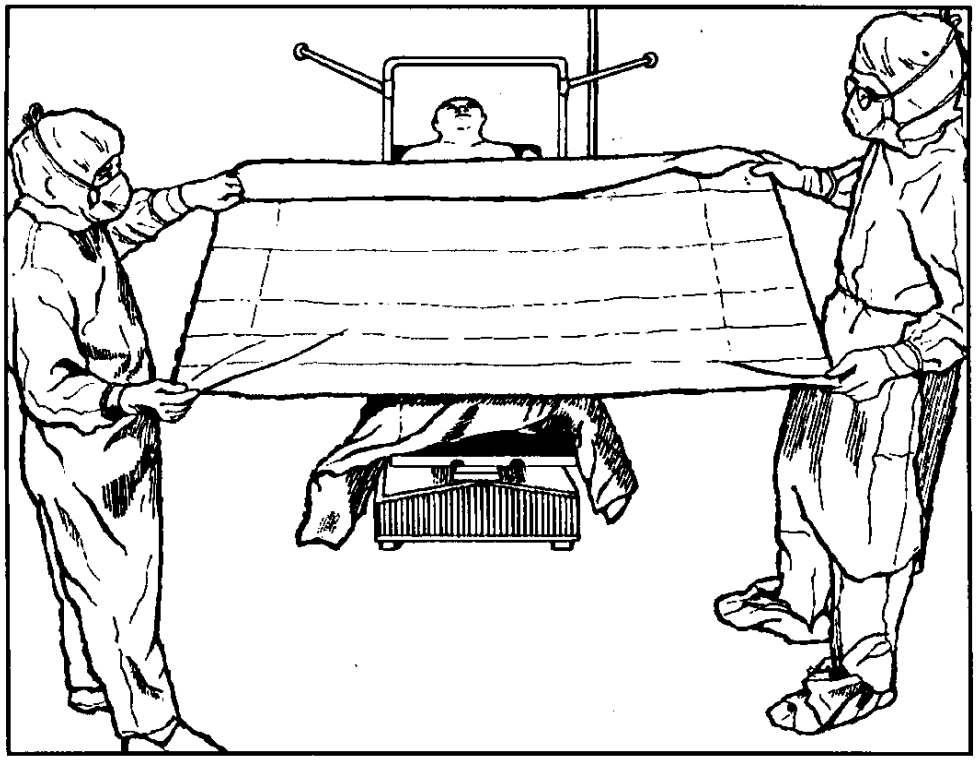


Figure 1-16 B. Laparotomy drape (continued).

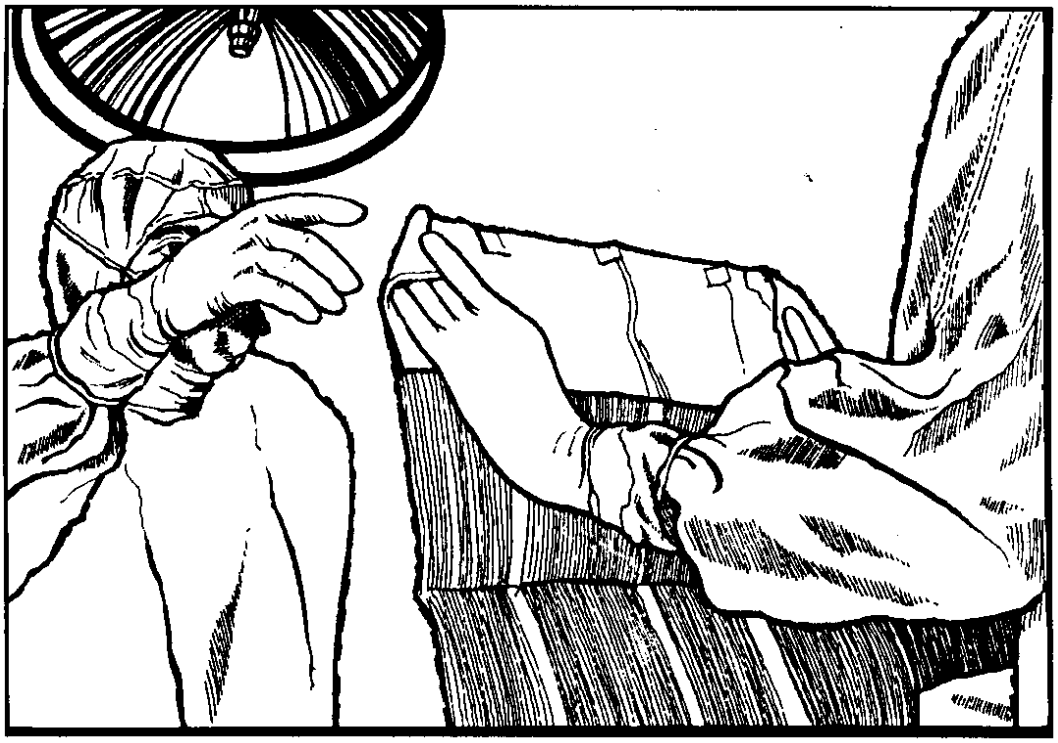


Figure 1-16 C. Laparotomy drape (continued).

Figure 1-16 D. Laparotomy drape (continued)

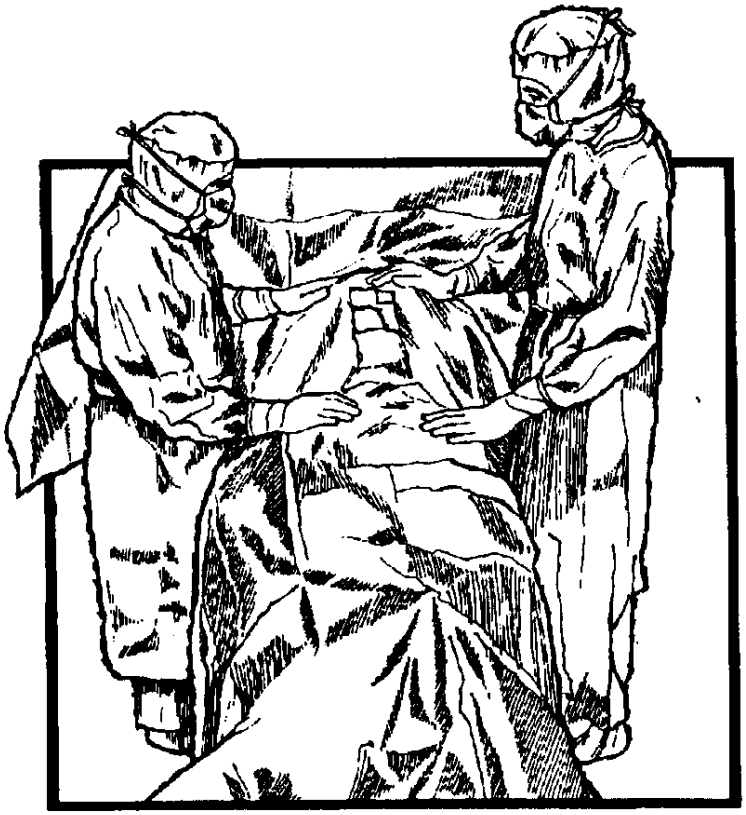


Figure 1-16 E. Laparotomy drape (completed).

c. **Other Procedure.** An alternative method of doing the laparotomy drape is to place as the first drape one of adherent plastic or to spray the patient's skin, after it has been prepped, with a sterile glue. Over this is applied a large sheet of very thin, sterile plastic which completely covers the operative field and extends beyond it about 1 1/2 feet on all sides. Drape sheets and laparotomy sheets are placed over this, as previously described. This procedure has three advantages. It eliminates the use of drape towels, provides a sterile field through which moisture from above cannot penetrate, and eliminates the need for skin towels, since the incision is made through the plastic and the edges of the incision remain covered.

1-26. LITHOTOMY DRAPE

a. **Use.** A lithotomy drape is used for urological, OB/GYN rectal, and other procedures of the perineal region when the patient is in the lithotomy position.

b. **Procedure.**

(1) The scrub checks and places the drapes in the proper order of use: lithotomy (perineal) sheet on the bottom, three hand towels, four towel clips, one sterile translucent plastic adhesive towel drape, and one drape sheet.

(2) The scrub gives the surgeon one drape sheet folded in quarters. The surgeon cuffs the sheet to protect his hand as he places the sheet under the patient's buttocks.

(3) If the procedure does not involve the anus or rectum, the scrub passes the plastic towel to the surgeon who then covers the anus. This procedure is omitted for rectal or anal procedures.

(4) The scrub passes two towels folded diagonally, one towel folded end-to-end, and four towel clips which are used to secure the towels. The handles are turned away from the operative site.

(5) Apply the perineal sheet by handing one end of it to the assistant, opening out the folds, and drawing the boots onto the feet and legs. Keep the hands on the outside of the sheet to avoid contaminating gloves and gown. The circulator assists from the reverse side of the drape.

(6) Many hospitals are now using the disposable type lithotomy packs to drape for procedures requiring the patient to be placed in the lithotomy position. These packs differ for each manufacturer. The directions are supplied with the packs and should be followed.

(7) The "sterile" team members unroll the upper portion of the sheet over the abdomen.

c. **Other Procedures**.

(1) Using four drape sheets. If a perineal sheet with leggings is not available, four drape sheets may be substituted as follows:

(a) The surgeon places one drape sheet under the patient's buttocks, folding a cuff of the sheet over his gloves.

(b) The surgeon places a rectal towel and three diagonally folded towels as previously described (see paras 1-26b(3) and (4)).

(c) The "sterile" team members place the second drape sheet over the patient's right leg and thigh, the folded edge covering the drape towel, and the loose edges of the sheet fastened with a towel clip behind the patient's leg; the opposite leg is draped in the same manner.

(d) The "sterile" team members may use a fourth drape sheet to drape the symphysis area and extend over the abdomen.

(e) The surgeon may require additional towel clips to fasten the leg drape sheets to the sheet under the buttocks.

(2) Using separate leggings. Another alternative method is the use of two drape sheets with a pair of separate leggings.

(a) The surgeon places the first drape sheet under the buttocks, as described paragraph 1-26c(1)(a).

(b) The surgeon and the circulator drape towels over the anus and the perineum as described paragraphs 1-26b(2), (3), and (4).

(c) The surgeon slips a sterile legging over each leg, protecting his hands with the cuff.

(d) The circulator assists from the opposite side of the leg.

(e) The surgeon may use additional towel clips to secure the leggings over the draped towels.

(f) The "sterile" team members place the second drape sheet over the symphysis area and extend it head-ward over the abdomen.

1-27. DRAPING A LIMB

The procedure for draping a limb for a general surgical procedure differs from the procedure done when orthopedic surgery is to be performed. Since the specialist will work with both types of cases, he must know how to drape for both.

a. **Draping for General Surgery.**

(1) Draping of the arm will be described to point out the method of draping for general surgery of a limb. Assume that the patient is to have a keloid (tumor) removed from the forearm.

NOTE: A lower leg may be draped using essentially the same procedure described below.

(2) Procedure. An armboard at least a foot wide or a Mayo stand is used as an operating table under the arm.

(a) The circulator is required to keep the arm elevated during the skin prep and part of the draping. He may support it by the elbow or by the hand. Holding it at the elbow is more satisfactory, because this enables the circulator to hold the arm while he stands outside the sterile field. In addition, the forearm may fall back on the upper arm unless held at the elbow. The arm is especially likely to fall back on itself if the patient has had a brachial block. (If the arm should fall back on itself, a second prep must be done.)

(b) The circulator should have an IV standard handy (near the head of the table) to which he may pin the edge of a drape sheet.

(c) The scrub checks and stacks the drapes in the proper order of use: two drape sheets at the bottom, the two hand towels, one cuffed as for a laparotomy drape and the other folded in half from end-to-end, three towel clips, and a drape sheet on top.

(d) While the circulator elevates the arm, the "sterile" team members place the first sheet, folded in quarters, over the armboard. It is necessary that the drape extend well below the end and over the sides of the armboard (but it should not touch the floor). The folds of the drape are toward the patient.

(e) A "sterile" team member places the hand towel folded in half on this drape sheet. The circulator can then lower the patient's arm, releasing it to place the patient's hand within the towel on the sheet.

(f) The surgeon folds this towel over the patient's hand and secures it with a towel clip. The towel must extend into the prepped area, limiting the distal edge of the field. (If the area to be operated upon is high on the forearm, two towels are necessary for the hand instead of one. They are fully opened and placed one on top of the other to create a sterile cover of two thicknesses.)

(g) The surgeon places the second hand towel so that it limits the proximal edge of the prepped area, and he places this towel over the arm rather than around it.

(h) Two "sterile" team members, one on either side of the armboard, open the second drape sheet in the usual manner so that the fold in the sheet is toward the operative area and over the proximal drape towel. The proximal edge may be fastened with towel clips on both sides of the arm to the drape sheet below, to prevent slipping. The upper, loose edge of the drape sheet, toward the patient's head, may be secured to an IV standard by the circulator.

(i) The "sterile" team members open the third drape sheet in the routine way and drape it lengthwise along the operative side of the patient to extend the sterile field. One end of this sheet overlaps the edge of the second drape sheet. No additional drapes are used for the patient's feet and the other side of his body, since they are well away from the sterile field.

b. **Draping for Orthopedic Surgery** (see figure 1-17). The drape for orthopedic surgery of a limb differs in some respects from that described in paragraph 1-27a.

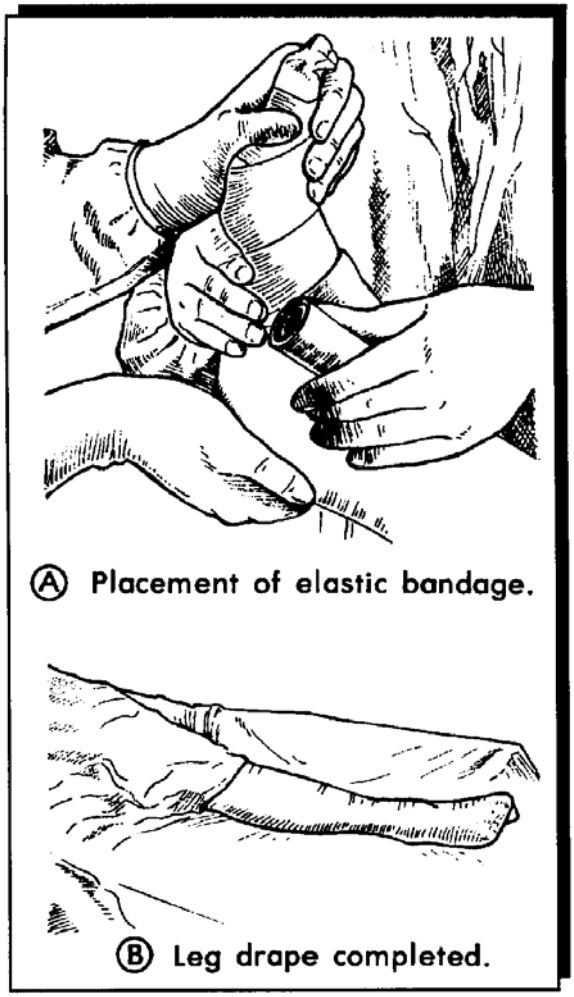


Figure 1-17. Orthopedic drape of a leg.

(1) Movement of limb. Orthopedic procedures usually require manipulation of the part during surgery to determine the degree and accuracy of fixation (in the case of fractures). Therefore, the drapes must be placed and secured in such a way that the part may be manipulated without dislodging the drapes.

(2) Covering for skin. Since the patient's skin cannot be made sterile, it is covered as completely as is feasible for the type of orthopedic operation to be performed, which means that additional draping is required as compared to general surgery. Stockinette is employed as an additional covering for the skin in orthopedic surgery.

(3) Procedure. The leg drape described below may be used for an open reduction with internal fixation of a fractured tibia and for all other orthopedic operations on this part of the leg. An orthopedic drape of an upper limb is done in a similar way.

(a) The circulator applies a pneumatic tourniquet to the thigh when the patient is placed on the table and prior to the surgical prep but he does not inflate the tourniquet at this time. He pads the skin beneath the tourniquet. The circulator supports the limb for skin preparation and part of the draping procedure.

(b) After the surgeon or a "sterile" team member has prepped all of the operative area except the foot, the circulator supports the leg at a point above the knee (using a sterile towel) and removes the covering from the patient's foot. For this surgery, the entire lower leg is prepped, from slightly above the knee footward, including the toes.

(c) The scrub checks the drapes and stacks them in the order of use: two or three drape sheets (as required) at the bottom, then one 6-inch elastic bandage, one 6-inch leg stockinette doubled, and one drape sheet on top.

(d) While the circulator supports the limb, two "sterile" team members open a drape sheet in the usual way and place it over the lower end of the operating table and over the unaffected leg, making sure that the end and sides of the table are well covered. Two thicknesses of material are sufficient for this drape since additional covering will be draped over it later.

(e) The surgeon (or other team member) then places stockinette over the foot and rolls it upward over the leg, keeping his fingers under the cuff of the stockinette to avoid contamination by the patient's skin. (When the surgeon has applied the stockinette to the knee, a "sterile" team member takes over the task of holding the leg, relieving the circulator.) The stockinette should be long enough to cover the edge of the tourniquet.

(f) The surgeon applies the elastic bandage from the toes to the tourniquet (see figure 1-17 A).

(g) The circulator inflates the tourniquet to the amount of pressure ordered by the surgeon. After inflation of the tourniquet, the "sterile" team members remove the elastic bandage and lower the leg to the table.

(h) The "sterile" team members open a second drape sheet; it has a 4-6-inch cuff, facing up, and is placed under the leg just distal to the tourniquet.

(i) The "sterile" team members place the third drape sheet over the leg with the 4- to 6-inch cuff facing down (see figure 1-17 B). Towel clips may be used to secure the upper and lower drape sheets together, one on each side of the leg.

(j) The surgeon may desire the placement of an additional sheet, to cover the patient from his lower abdomen and extending headward, over the anesthetist's screen. If the scrub knows that a fourth sheet will be required, he places it at the bottom of the stack of drapes; but if the use of this sheet has not been anticipated the circulator obtains the sterile sheet.

c. **Developing Skill in Draping.** Preplanning and continued practice will develop the skill needed for correct draping. The surgeon depends on the specialist to know what he will need and how each piece of drape is to be handled. This requires a careful check of all draping materials before each operative procedure.

Continue with Exercises

EXERCISES, LESSON 1

INSTRUCTIONS. The following exercises are to be answered by marking the lettered response that best answers the question or best completes the incomplete statement or by writing the answer in the space provided.

After you have completed all the exercises, turn to "Solutions to Exercises" at the end of the lesson and check your answers with the solutions.

1. To place the patient in the Trendelenburg position, you should first place him in the _____ position.

   a. Supine.

   b. Lithotomy.

   c. Jackknife.

   d. Reverse Trendelenburg.

2. As the circulator, you are placing the patient in a surgical position that requires the use of shoulder braces. On what part of the patient's shoulder should you place the braces?

   a. Midway between the neck and the outer part (bony joint) of the shoulder.

   b. Over the bony joint of the shoulder.

   c. Adjacent to the patient's neck.

   d. None of the above.

3. When placing the patient in the supine position with arm extension, you should be sure to place the patient's arm on a padded board that is in which of the following positions with respect to the OR table?

   a. At 100º angle.

   b. At less than 90-degree angle.

   c. Slightly lower than the table.

   d. Slightly higher than the table.

4. The Trendelenburg position is often used for operations on the:

    a. Rectum.

    b. Bladder.

    c. Thyroid.

    d. Gallbladder.

5. When shaving the patient's skin, you should use:

    a. Short strokes.

    b. Long, smooth strokes.

    c. Long strokes on extremities and short strokes on other areas.

    d. Short strokes in the pubic region and long strokes on other areas.

6. While you are prepping a patient for minor surgery, he says: "I feel worried about my operation, I might die." Your response should be which of the following statements in accordance with the principles given in the mental preparation of the patient?

    a. "I know just how you feel, buddy. I'm with you."

    b. "It's normal to feel worried, but we haven't lost a case like yours yet."

    c. "Your surgeon could do this little routine business of yours blindfolded."

    d. "It's normal to be worried, but your surgeon and the team helping him are highly skilled."

7. You are working as a scrub. You are gowned, gloved, and are setting up sterile goods for an operation. Which of the following statements represents the task of the first importance?

   a. Keeping the items sterile.

   b. Putting each item in its appropriate place on the table.

   c. Arranging each piece of furniture carefully in its appropriate place.

   d. Having the circulator remove all kick buckets from the sterile area.

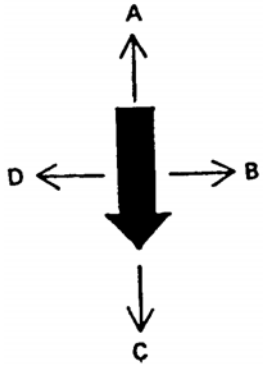
8. The heavy arrow illustrates the direction of hair growth in the area of the patient's body that you are to shave for the surgical prep. Indicate the direction in which you should shave the area:

   a. A.

   b. B.

   c. C.

   d. D.



9. Which of the following statements is correct concerning a patient that is properly placed in the Kraske position?

   a. Hips are placed as for the lithotomy position.

   b. Hips are directly over the upper break of the table.

   c. Knees are directly over the central break of the table.

   d. Hips are directly over the table break and the table is flexed at a 90º angle.

10. You are the circulator for an operation to be done using general anesthesia. Which of the following statements best represents the procedure that one should follow concerning the placement of the patient in the desired position for surgery?

    a. Leave the room to obtain help when the anesthetist orders the patient positioned.

    b. Ensure that personnel needed to assist in positioning the patient are in the room before induction of anesthesia begins.

    c. Remove the sheet covering the patient and begin positioning the patient when the anesthetist indicates that the patient is ready.

    d. Ask the scrub to place a sterile sheet over the patient and then help you position the patient when the anesthetist orders that the patient be positioned.

11. Which of the following remarks is most appropriate for you to say to the patient about his preoperative shave?

    a. "I am going to prep you to help maintain asepsis."

    b. "I am going to shave you so you won't die of infection after your operation."

    c. "I am going to shave you to help make your skin as free from germs as possible."

    d. "I am going to shave you for the operation; let's both hope the razor doesn't slip."

12. You are the circulator, and your next task is to place a patient in the side-lying position for spinal anesthesia. When the position is correct, the spinous processes of the patient's vertebrae will be in what position with relation to the table?

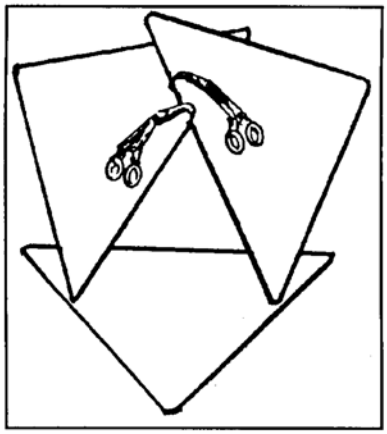
    a. Parallel.

    b. 45º angle.

    c. 100º angle.

    d. Perpendicular.

13. The patient is in the lithotomy position and the towels are in place. What, if anything, is wrong with the picture?



a. Towels draped laterally are incorrectly placed. They should overlap each other over the towel draping the rectum.

b. Towel draping the rectum is incorrectly placed. It should be in the reverse position.

c. Towel clips are incorrectly placed. Handles should point away from incision.

d. Nothing is wrong.

14. Draping for orthopedic surgery on a limb is done to ensure that the limb:

a. Can be moved without dislodging the drapes.

b. Can be moved by allowing movement of drapes.

c. Will be immovable, thus allowing drapes to remain undisturbed.

d. Can be easily manipulated by leaving the operative area free from drapes.

15. You should have the patient flex his spine for administration of spinal anesthesia because doing this has which of the following desired effects?

a. Opens the vertebral interspaces.

b. Protects the patient from impairment of respiration.

c. Enables you to hold the patient in position more readily.

d. Enables the patient to remain comfortable during the procedure.

SITUATION for Exercises 16 and 17. You are the circulator for an orthopedic operation for which a pneumatic tourniquet is to be applied and inflated.

16. When is the tourniquet applied?

    a. Just prior to the surgical prep.

    b. Just prior to placement of the drapes.

    c. Immediately following the surgical prep.

    d. Just prior to the administration of anesthesia.

17. When is the tourniquet inflated?

    a. Immediately on application.

    b. After the drapes have been placed.

    c. As soon as the surgical prep is done.

    d. After the elastic bandage has been applied.

For exercises 18 through 28: Each numbered exercise in Column I can be matched **BEST** by one of the lettered choices in Column II. You may use any choice in Column II for as many exercises as you wish; however, there is only **ONE BEST** answer to each exercise.

COLUMN I	**COLUMN II**
Characteristics of Positions	**Surgical Position**
_18. Patient is supine with legs flexed and feet supported by canvas straps.	a. Modified supine.
_19. Table may be flexed slightly at both breaks or knees flexed with a small pillow.	b. Trendelenburg.
_20. Patient is supine with head higher than rest of body.	c. Reverse Trendelenburg.
_21. Patient is prone with hips higher than rest of body.	d. Sitting.
_22. Foot section of table is lowered out of the way.	e. Sitting for spinal anesthesia.
_23. Patient sits on table, feet resting on footboard.	f. Lithotomy.
_24. Table is flexed to angles of about 30-40 degrees at the knees, and the head is lowered 30-40 degrees.	g. Jackknife
_25. This position is used for thyroidectomy.	
_26. Specialist holds and supports the patient.	
_27. Well-padded shoulder braces are placed.	
_28. Patient sits on table, feet resting on a stool.	

29. You are the scrub. You and the surgeon are to drape a patient, and the surgeon is preparing to place the towels. You should:

a. Go to the surgeon's side of the table.

b. Hand the towels across the table to the surgeon.

c. Place the towels on the patient from a position opposite the surgeon.

d. Go to the foot of the table and motion to the surgeon that you are ready.

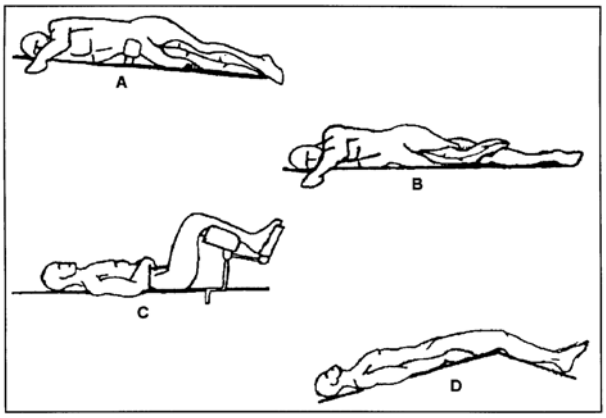
30. Which of the following illustrations most closely represents the Trendelenburg position?

a. A.

b. B.

c. C.

d. D.



Check Your Answers on Next Page

SOLUTIONS TO EXERCISES, LESSON 1

1. a (para 1-15c(1); figures 1-5, 1-6)

2. b (para 1-15c(3); see also para 1-13e (3))

3. b (para 1-14e(6))

4. b (para 1-15a)

5. a (para 1-10e(12))

6. d Response d is the best selection. In this statement, the specialist affirms the patient's right to feel worried; then he reassures the patient concerning the competence of the surgical team, thus indicating to the patient that the specialist is confident that the planned surgical treatment will be successful. Note also that this response refrains from implying that the surgical team regards the patient as a "case." (para 1-9)

7. a (para 1-3)

8. c (para 1-10e(12); figure 1-2)

9. d (para 1-21c(2); figure 1-12)

10. b (para 1-13d(4))

11. c Choice c is the best reply. It explains the procedure in terms that can be understood without alarming the patient. (para 1-10e(3), see also paras 1-5, 1-6, 1-7, 1-9)

12. a (para 1-23b(1); figure 1-14 B)

13. c One of the three towel clips normally used in the lithotomy drape is omitted from the illustration accompanying exercise 13 since it should be partially obscured by the towels overlapping over the symphysis pubis. It was also omitted in order to avoid distracting from the teaching point, i.e., that the two visible clips are erroneously placed with their handles turned toward the operative site. (para 1-26b(4))

14. a (para 1-27b(1))

15. a (para 1-23b(1), (2)(b))

16. a (para 1-27b(3)(a))

17. d (para 1-27b(3)(f),(g))

18. f (para 1-19d(3) and (4); figure 1-10)

19. a (para 1-14e)

20. c (para 1-16c(1)-(4); figure 1-7)

21. g (para 1-21c(1), (6); figure 1-12)

22. f (para 1-19d(6))

23. d (para 1-22c(1), (5), (7); figure 1-13)

24. b (para 1-15c(4), (5); figure 1-6)

25. a (para 1-14e(3))

26. e (para 1-23c(2)(c); figure 1-15)

27. b (para 1-15c(2); figure 1-6)

28. e (para 1-23c(2)(a); figure 1-15)

29. a (para 1-25b(4))

30. d (para 1-15c(4), (5); figure 1-6)

End of Lesson 1

LESSON ASSIGNMENT

LESSON 2	Procedures in Preparing Materials.
LESSON ASSIGNMENT	Paragraphs 2-1 through 2-13.
LESSON OBJECTIVES	After completion of this lesson, you should be able to:

2-1. Identify basic instruments used in operations.

2-2. Identify types of sutures and their uses.

2-3. Identify the purposes of primary, secondary, and third intentions.

2-4. Identify techniques of approximating tissue and characteristics of each technique.

2-5. Identify the procedures for preparing sutures for use and for handling sutures.

2-6. Identify the procedures for preparing and handling tissue specimens.

2-7. Identify the procedures for handling cultures.

2-8. Identify the procedures for handling tissue being processed for storage.

SUGGESTION After completing the assignment, complete the exercises at the end of this lesson. These exercises will help you to achieve the lesson objectives.

LESSON 2

PROCEDURES IN PREPARING MATERIALS

Section I. INFORMATION ON FILE

2-1. INTRODUCTION

Certain files that provide important information for the OR specialist and other members of the OR team are located in the surgical suite. Among these files are: the instrument card file which concerns the instruments necessary for a particular surgical procedure; the suture cards (surgeon's preference cards) which contain the type of sutures, needles, and stitches preferred by individual surgeons; and the procedure manual which contains local policy for the performance of certain tasks, including the care and preparation of specimens. Section II of this lesson presents a discussion on sutures.

2-2. KARDEX FILE

Cards in this file contain information as to basic instruments and certain other items that are used for the various operations to be performed.

a. **Basic Instruments.** These are the instruments that may be used to perform an operation. Therefore, each card has recorded on it the names of instruments needed, the sizes (whenever different sizes are available), and the number of each kind of instrument to be included. The selection of instruments for a given operation can be made by the OR specialist by following the information recorded on the appropriate instrument card.

(1) Instruments are identified by name in several ways.

(a) Name of the designer of the tool. Examples are shown in figure 2-1 A thru D.

Kelly forceps	*Babcock forceps*
Mayo curved scissors	*Hegar-Mayo suture needle*

(b) Specific anatomical part or organ and function. Examples are shown in figure 2-1 E thru G.

Conjunctival forceps	*used to remove foreign bodies from the eye.*
Laryngeal mirror	*used to inspect the larynx.*
Bullet extracting forceps	*designer's name and functional name.*

(c) Peculiar identifying characteristics. Examples are shown in figure 2-1 H and I.

Mouse-tooth forceps	*sharp pointed teeth on the grasping end.*
Double blunt uterine scissors	*tips of both cutting blades rounded or blunted.*

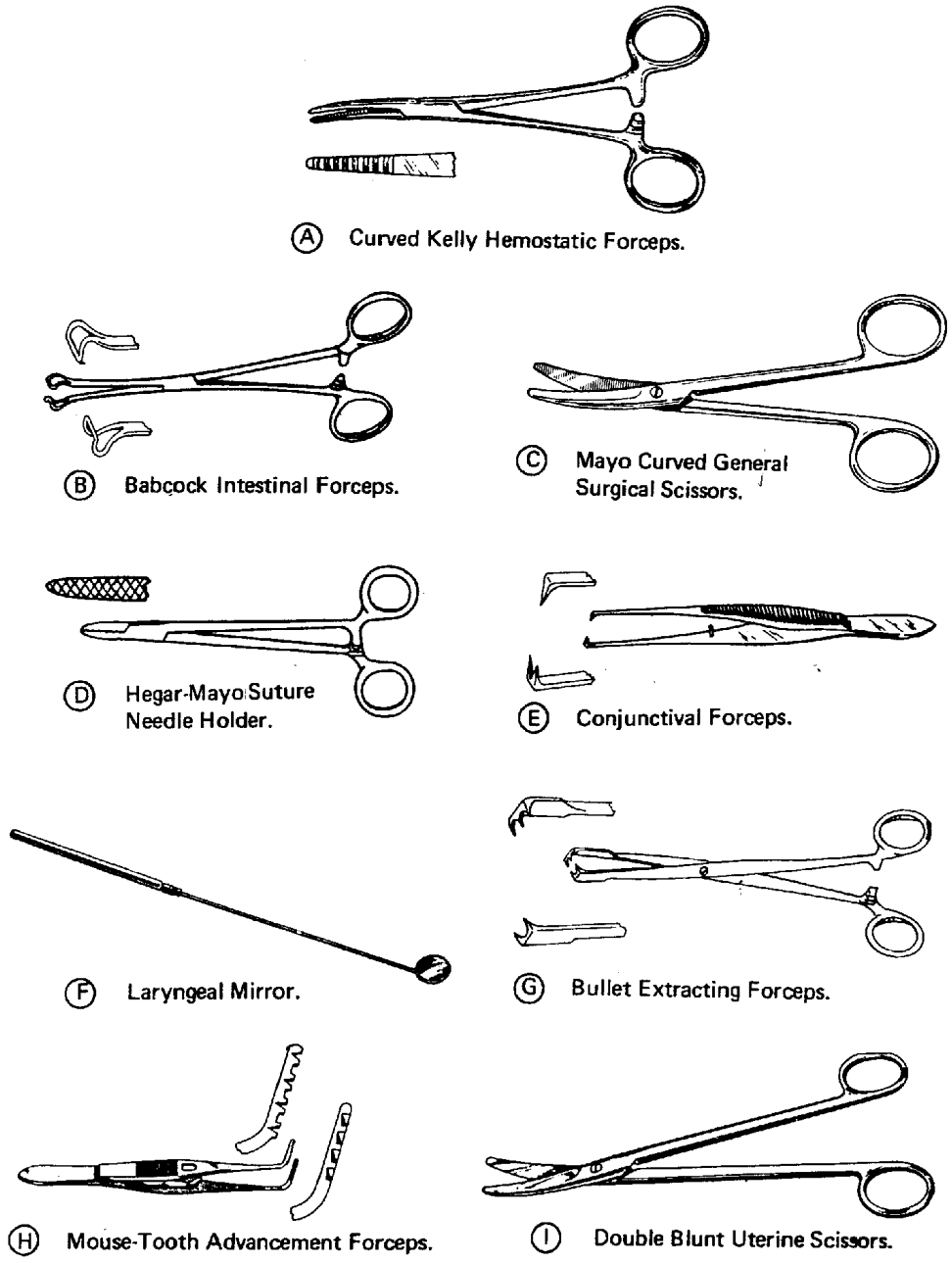

A Curved Kelly Hemostatic Forceps.
B Babcock Intestinal Forceps.
C Mayo Curved General Surgical Scissors.
D Hegar-Mayo Suture Needle Holder.
E Conjunctival Forceps.
F Laryngeal Mirror.
G Bullet Extracting Forceps.
H Mouse-Tooth Advancement Forceps.
I Double Blunt Uterine Scissors.

Figure 2-1. Instruments and their identification.

(2) During an operative procedure, the surgeon may use various means of asking for a particular instrument. He may ask for it by proper or designer's name, by functional name, by a combination of both proper and functional names, or by sign language. By sign language, he may indicate his wishes for scissors by moving his forefinger and index finger in a scissors-cutting motion; by holding those fingers together motionlessly, he indicates a need for a hemostat; and by moving his index finger and thumb together, he may indicate a need for grasping (pickup) forceps.

b. **Other Items.** Non-instrument items (such as drains and safety pins) needed to perform the operations are also listed in the Kardex file.

Section II. HANDLING AND USE OF SUTURES

2-3. INTRODUCTION

The OR specialist hears the surgeon's request for "suture" in practically every surgical procedure. Because he handles sutures for use by the surgeon, the specialist must be able to identify them by their correct name and size. Following are appropriate terminology and descriptions concerning sutures.

a. **Suture.** A suture is a piece of thread-like material used to stitch or approximate tissues, and hold the wound together until healing takes place.

b. **Absorbable Suture.** An absorbable suture is made from material that can be absorbed (digested) by body cells and fluids. Rate of absorption depends on various factors, including type of body tissue, nutritional status of the patient, and the presence of infection. Absorbable suture is available prepackaged and presterilized in various sizes graded by diameter and length. Sizes range from number 12-0, which is the finest, to number 5, which is the heaviest. The length ranges from 12 to 60 inches.

(1) Plain gut. Plain indicates a surgical gut material that has not been treated to lengthen its absorption time in the tissue. This suture is absorbed more rapidly than treated suture. Plain gut suture is chosen most often by the surgeon for use in tissues that heal rapidly. As an example, plain suture is used extensively in tying off subcutaneous bleeding points. Its source is the sheep's intestine or beef serosa.

(2) Chromic gut. The second suture material in the absorbable category is the chromic surgical gut. Chromic surgical gut has been treated with chromic oxide so that it will delay its rate of digestion or absorption. Chromic sutures are treated to different (mild and medium) degrees to retard absorption. Its source is the same as that of plain surgical gut. It is used in tissues that have a relatively slow rate of healing and need support for a longer period. (An example is fascia.)

c. **Nonabsorbable Suture.** This suture material is not absorbed during the healing process. Nonabsorbable suture becomes encapsulated (enclosed in a capsule) with tissue and remains in the body until it is removed or cast off. Silk, nylon, cotton, and corrosion-resisting steel wire are examples of nonabsorbable sutures. Sutures used for skin closure are usually removed before healing is complete.

(1) Silk. Silk suture material is obtained from the continuous thread spun by the silkworm. Silk is used principally in clean surgery such as tendon repair, hernia repair, and surgery involving the nerves and blood vessels. It ranges in size from very fine number 9-0 used in eye surgery, to heavy number five used as a retention suture.

(a) Like the absorbable sutures, silk is available prepackaged, precut in many strands, and presterilized. Prepackaged, precut, and presterilized sutures usually are 18 inches long for interrupted sutures and 24 to 30 inches for continuous sutures.

(b) Silk is available braided and twisted. Braided is most commonly used because of the added tensile strength provided by the braiding process. Silk is treated so that it is noncapillary; that is, it is treated so that moisture and bacteria cannot enter the spaces or gaps within the woven silk fibers.

(2) Nylon. Nylon is a synthetic material most commonly used in plastic surgery. Nylon is stronger than silk. Nylon sutures are available in monofilament (single strand) in sizes ranging from number 5-0 to 0, and the multifilament (braided) in sizes from number 6-0 to 5.

(3) Polypropylene. Polypropylene is a clear or pigmented polymer. This monofilament suture material is used for cardio-vascular, general, and plastic surgery. Polypropylene is extremely inert in tissue, has high tensile strength, causes minimal tissue reaction, and holds knots well. Surgeons have indicated that polypropylene sutures can be tied into more secure knots than most other synthetic suture materials. Sizes available are number 7-0 to 2, swaged to needles.

(4) Linen. Surgical linen is made of twisted linen thread that has sufficient tensile strength to be used as suture material. It may be impregnated with a nonpermeable material that makes it smooth and noncapillary. Linen is used almost exclusively in gastrointestinal surgery, sometimes as a purse-string suture around the stump of the appendix or as a skin suture.

(5) Cotton. Surgical cotton is a nonabsorbable suture that is made from long staple cotton treated to make it smooth. Cotton is used in the same areas in which silk is used. It is available in size number 5-0 to 2. It is also available prepackaged, precut, and presterilized. Cotton suture is twisted rather than braided. It is free from lint, fuzz, and knots, and has a smooth shiny surface. Ordinary cotton has neither the smoothness nor the tensile strength required for suturing.

(6) Steel. Corrosion-resisting steel wire is used for metallic sutures. It is available precut, prepackaged, and on spools. It is also available in single strands (monostrands) and multistrands several strands of small diameter twisted together). Corrosion-resisting (stainless) steel is available in sizes ranging from number 6-0, fine to 2, heavy. Steel size may also be expressed in gauge: 18 to 40.

d. **Dead Space.** Space caused by a separation of wound edges that have not been closed by sutures is dead space. A dead space may interfere with healing.

e. **Ligature (tie).** A ligature is a thread-like material used to tie off a blood vessel or other tube-like tissue. A ligature or tie is usually of the same material as that used for sutures, but in some cases, it may be a silver clip.

f. **Stick-tie (Suture-ligature).** This is a ligature threaded on a needle and used to suture a vessel wall in addition to being tied around the vessel.

g. **Tensile Strength.** This refers to the amount of weight or pull that may be exerted on the suture before it will break.

h. **Primary Suture Line.** A line of sutures that holds the wound edges in approximation is known as the primary suture line.

i. **Secondary Suture Line.** A line of sutures that relieves the primary suture line of unusual stress, decreases or obliterates dead space, and prevents the collection of serum in the wound known as the secondary suture line or retention stitch.

2-4. METHODS OF WOUND HEALING

To understand why a wound is sutured, the specialist must know how healing occurs. Injured tissue is replaced by fibrous connective tissue (scar tissue), and the healing process may be classified as follows:

a. **Primary Intention.** The type of healing that occurs when an aseptic, incised wound is closed with sutures is primary intention. The healing takes place at all levels of the incised area; there is no swelling, no infection, and no separation of wound edges. A minimum of scar tissue ("hairline" scar) follows this type of healing.

b. **Secondary Intention.** Secondary intention is the healing that occurs from the depth of the wound outward or upward, each layer healing separately by granulation of tissue. This kind of healing is usually attended by the formation of a large amount of scar tissue, or it may be characterized by a weak union of tissue that breaks down later. This type of healing may occur as the result of one of a number of factors, including the following: poor physical condition of the patient, excessive trauma to tissue, loss of tissue, and infection. In the presence of infection, the surgeon leaves the wound open purposely in order to be able to keep it cleansed and dressed while it is healing. Whatever the reason is for healing by secondary intention, the union is delayed.

c. **Third Intention.** When gross infection exists, when a large amount of tissue is removed, and for some battle wounds, surgeons may leave wounds open for about four to seven days to observe them for development of infection. Nevertheless, when it can be done, primary intention is preferred over third intention because, in the former, minimum scar tissue results, healing occurs more rapidly, less chance of contamination occurs, and a stronger union of tissue results.

2-5. TYPES AND LAYERS OF TISSUE REQUIRING CLOSURE

In order to accomplish wound closure, the sutures are placed to hold the edges of the tissue layers in approximation until the wound is fairly well healed. The tissue layers that require closing vary with the body area involved. For example, the tissue layers closed in abdominal surgery differ from the layers closed in orthopedic surgery.

a. **Abdominal Surgery.** The layers of tissue to be closed, beginning with the deepest layer and going toward the periphery, are: the peritoneum, the deep fascia, the muscle, the superficial fascia, the subcutaneous tissue, and the skin. (There are two layers of fascia since muscle tissue is covered or enclosed in fascia.) Many times the muscle and one layer of fascia are sutured together because these structures are immediately adjacent to each other.

b. **Orthopedic Surgery.** The layers of tissue to be approximated following bone surgery (for example, the tissue over the humerus) are: the periosteum or bone covering, the deep fascia, the muscle, the superficial fascia, the subcutaneous tissue, and the skin.

2-6. TECHNIQUES OF APPROXIMATING TISSUE

Techniques of approximating tissue and the nomenclature for the various type of stitches are discussed in the following paragraphs.

NOTE: Figure 2-2 shows the principle suturing techniques.

a. **Continuous Stitch** (See figure 2-2). This is a running stitch with the suture tied only at the ends of the incision.

b. **Interrupted Stitch** (See figure 2-2). With this technique, each stitch is taken and tied separately. Each stitch may be tied when it is put in place, or the stitches may be tied after all have been placed.

c. **Purse-String Stitch** (See figure 2-2). This is a continuous stitch placed so that it can be closed in a drawstring manner. The technique is to place a running stitch around the lumen of a structure. For example, it is used to close the intestinal wall when the appendix is removed and the stump inverted. After placement, the suture is tightened by grasping both ends and drawing the lumen closed.

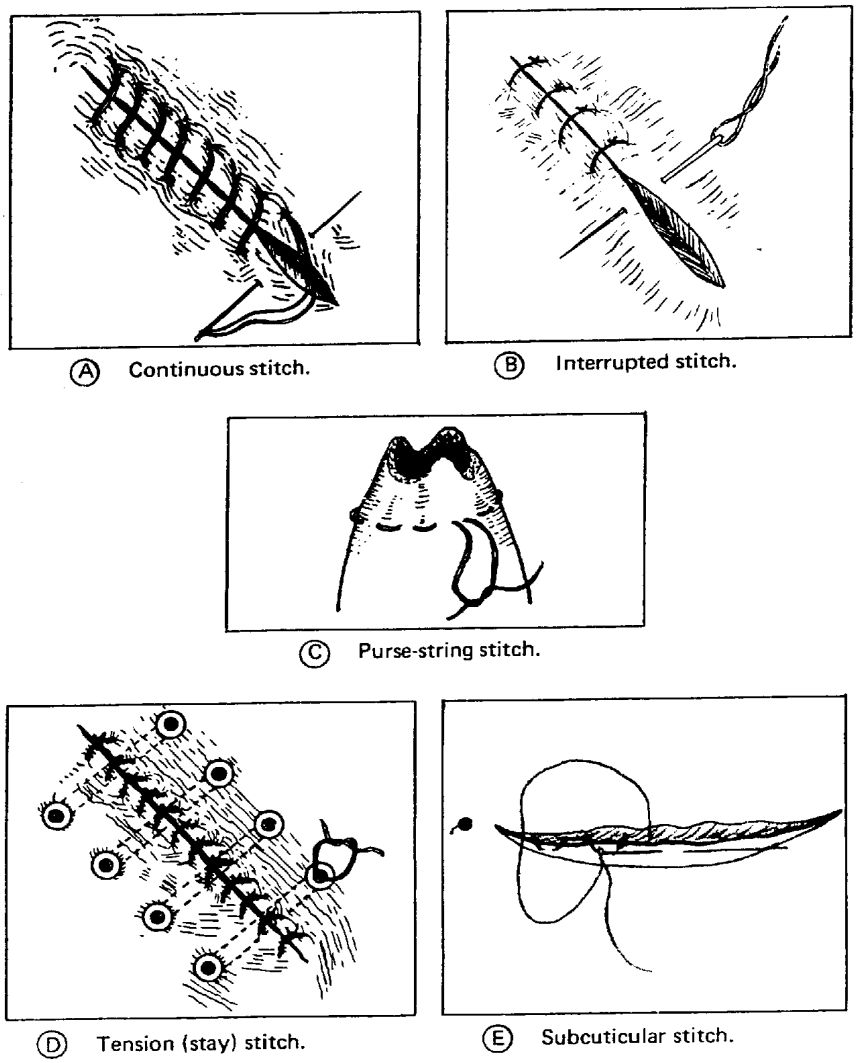


Figure 2- 2. Principal suturing techniques.

d. **Tension (Stay or Retention) Stitch** (See figure 2-2)**.** This is an interrupted stitch used to reinforce a primary suture line. The suture is placed through many layers of tissue on each side of the incision (down to and sometimes including the peritoneum (serous membrane lining the abdominal cavity). Stay sutures are of a heavy, nonabsorbable material, such as wire or heavy silk (sizes 2 or 3). When a heavy suture is used, the skin beneath the knot must be protected to prevent its being cut by the suture. Therefore, when silk is used, surgical buttons may be used on both ends of the suture where it is tied. When wire is used, rubber shods (small pieces of rubber tubing) are used to protect the skin where the wire is tied. The rubber shods extend over the incision line.

e. **Subcuticular Stitch (See figure 2-2)**. With this technique, short continuous stitches are taken laterally inside the incision. The stitches are placed in the dermis. The suture is brought through the surface of the skin at each end of the incision only and is secured by either clamping a perforated lead shot on each end of it or tying it at each end. This technique of skin closure leaves a minimal scar; therefore, it is used frequently for closing the skin of the face and neck and for surgery done on children. The suture may be removed by cutting off one end and pulling the entire suture out at the other end. However, if the suture is absorbable, the surgeon may prefer to leave it in permanently.

2-7. SURGEON'S PREFERENCE FOR SUTURES AND STITCHES

a. **Types of Sutures to be Used.** The surgeon prescribes the types of sutures, needles, and stitches required for wound closure. This information is entered on a surgeon's card (see figure 2-3) for each surgeon and each operation. The cards are kept on file in the surgical suite. The specialist obtains this information by checking the card file. Information is entered on the card in an abbreviated form, and the specialist is expected to be able to understand the information in order that he may correctly prepare the necessary sutures for the procedure.

b. **Example of Entries on Cards.** Assume that Dr. Able is to perform an appendectomy, and the card shown in figure 2-3 is to be used.

SAMPLE APPENDECTOMY CARD

APPENDECTOMY **Dr. ABLE**
glove size--8 1/2

number 000 plain ties

number 3-0 black silk-- French-eye needle--purse-string

number 0 Chromic--number 3 Murphy needle--continuous--peritoneum

number 0 Chromic-- number 3 Murphy needle--interrupted—muscle and fascia

number 000 plain ties-- number 2 Murphy needle--interrupted—subcutaneous

number 3-0 black silk--Keith needle--interrupted--skin

Figure 2-3. Suture (surgeon's preference) card.

(1) Plain size 000 ties (ligatures, para 2-3e). This indicates that "free" pieces of plain size 000 catgut are desired to tie off cut blood vessels in the subcutaneous tissues. The suture may be wound around an unbroken suture tube or cut in 15-inch (single) lengths, depending upon the surgeon's desire.

(2) Size 3-0 black silk--French-eye needle--purse-string. This means that size 3-0 silk, about 18 inches long, will be required for the purse-string, and that the silk is to be threaded into a French-eye needle. The purse-string stitch will close the lumen in the cecum after the appendix has been removed.

(3) Chromic 0-size 3 Murphy needle--continuous--peritoneum. This information means that a single suture of chromic size 0 with a Murphy needle size 3 is required to close the peritoneum, and that a continuous suture is used. Since a continuous suture is tied only at the ends of the incision, the length of suture needed for this closure depends upon the length of the incision. For many operations, half of a strand of suture is sufficient.

(4) Chromic 0-size 3 Murphy needle--interrupted--muscle and fascia. "Chromic 0" and "size 3 Murphy" have the same meaning as in (3) above. "Interrupted" means that this surgeon will place and tie each stitch separately when closing the muscle. The length required for interrupted suture is usually 15 inches long. However, the suture may need to be shorter or longer, depending upon the depth of the tissue layer.

(5) Plain 000--size 2 Murphy needle--interrupted--subcutaneous. This indicates that for closure of the subcutaneous tissue, the surgeon requires plain size 000 surgical gut (in quarter lengths) on a size 2 Murphy needle, and that he will take each stitch separately. The needle is of a larger size (see figure 2-4) than that mentioned in (4) above in order that it will go through the subcutaneous layer of tissue.

NOTE: The higher the number of a needle, the smaller the needle.

(6) Size 3-0--black silk--Keith needle--interrupted--skin. According to this notation, the surgeon will close the skin using a Keith (straight) needle that is used without a needle holder. Each stitch is taken separately, the size 3-0 silk should be about 15 inches long.

c. **Specialist's Duties in Maintenance of Card File.** The cards may be taken into the OR for use, but the specialist who uses them has the responsibility of returning them to their proper place for future reference. The specialist has further duties in the maintenance of this file, as follows:

(1) Change in the surgeon's routine. The surgeon is at liberty to change his suture routine at any time. Whenever he does so, the scrub must report these changes to the OR supervisor in order that the changes may be entered on the card.

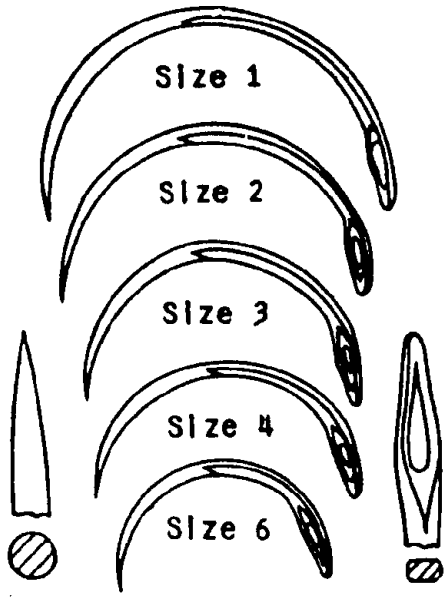


Figure 2-4. Sizes of needles.

(2) Preparation of new cards. When a surgeon, new to a hospital, operates for the first time, the specialist assigned for the case has the responsibility of making a list of the sutures, the types of stitches, and the needles desired. The list is given to the OR supervisor in order that the information may be entered on a card.

2-8. PREPARATION BY SPECIALISTS

a. **Circulator.** The circulator supplies the necessary kind and amount of sutures required for the operative procedure, according to the information listed on the card for the surgeon and the operation.

b. **Scrub.** The scrub prepares all needed sutures for the case and hands them to the surgeon at the appropriate time. The scrub's first step in the preparation of sutures is to check the appropriate card for the operative procedure before scrubbing.

2-9. PROCEDURES FOR PREPARATION OF SUTURES

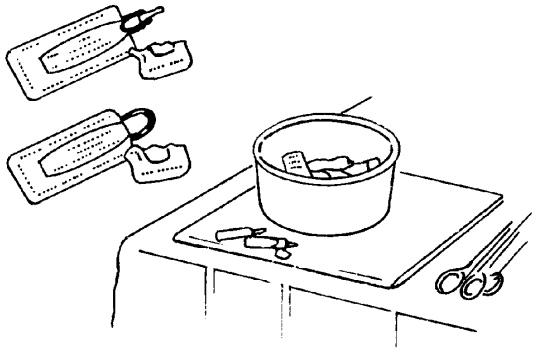
Sutures used in the OR are in a plastic packet or foil packet. First identify them; then open them. When preparing sutures, always prepare them in order of use.

a. **Opening Individual Sealed Containers.** To open a foil packet, cut near the sealed edge or tear along the dotted line of the packet and withdraw the suture (see figure 2-5 A).

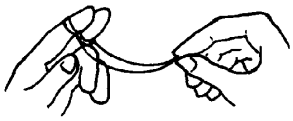
b. **Unwinding the Suture.** To unwind the strand of suture, break a prong off the reel. Place one or two fingers within the center of the loop while carefully unwinding and straightening out the suture (see figure 2-5 B). Straighten the suture as follows: hold both ends of the suture in one hand, the center of the loop in the other, and gently pull the hands apart (see figure 2-5 C). **Never stretch, jerk, nor test the strength of suture while handling it, as this would weaken the strand. Do not run gloved hands over the suture to straighten kinks, and do not handle the suture any more than is necessary. Always work over the sterile field as a precaution against contamination. Avoid letting the suture ends drop over the edge of the table.** The procedure for opening a package with a swaged-on or a traumatic (affixed) needle is as that just described, except for two points:

(1) After taking the suture from the package, grasp the end of the suture with one hand; grasp the other end of the suture, just below the needle, with the other hand.

(2) With the hands in the position described, gently straighten the suture. Do not exert any pull on the needle.



Ⓐ Open foil packet.



Ⓑ Unwind suture.

Figure 2-5. Preparation of sutures.

c. **Cutting the Suture into Lengths.** The next step is to cut the suture into lengths appropriate for its use and place it under the cover towel on the Mayo tray in the order of use. Standard absorbable suture comes in several lengths: 12, 18, 27, 36, and 54 inches. If necessary, this suture is cut into halves, thirds, and fourths, and so forth, depending upon the area in which it is to be used and the original length. Prepackaged silk suture comes in lengths of 18, 24, 30, 40, and 60 inches and on spools.

d. **Threading a French-Eye Needle (See figure 2-6)**. Thread a French-eye needle by bringing the suture down through the slit into the eye. Be careful when threading a French-eye needle because the eye is easily broken. There is a spring opening through the end of the needle into the eye. French eye needles are easily broken. **Check to see that the needle's eye is intact before threading.**

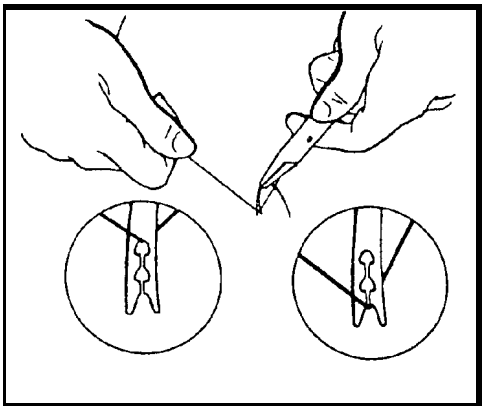


Figure 2-6. Threading a French eye needle.

e. **Threading Other Curved Suture Needles (See figure 2-7)**. Thread the needle from inside its curve with the short end of the suture on the outside. This method helps prevent unthreading. Proceed as follows: grasp the needle on its flat surface about one inch away from its eye with a needle holder. Pull about 5 inches of the suture through the eye of the needle.

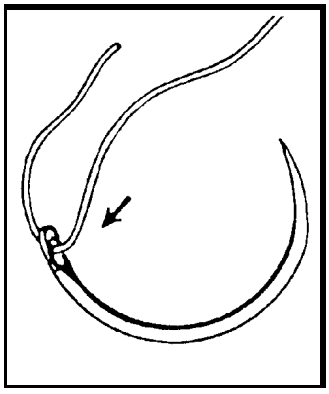


Figure 2-7. Threading of a curved suture needle.

2-10. PROCEDURES FOR HANDLING OF SUTURES

After handing a tie or suture to the surgeon, hand suture scissors to his assistant.

a. **"Free" Ties.** Hand the length of suture on the reel to the surgeon when he is ready for it. If the surgeon prefers to handle each tie separately, hand quarter-length strands (15 inches) to the surgeon one at a time by holding one end of the strand in each of your hands and placing the strand with gentle pressure across the palm of the surgeon's hand.

b. **Stick-Ties.** Thread a quarter-length ligature on a curved, cutting-edge needle (a longer suture may be needed if the surgeon is working very deep). When the surgeon requests a stick-tie, clamp the needle firmly with the needle holder about 1/3 inch from the eye to prevent unnecessary stress on the needle, possibly causing it to break when passed through the tissue. Pass the needle holder to the surgeon by placing the handle firmly into his palm, the needle pointing as for use and the suture material falling over the back of the hand, out of his way, and so that he may place the suture without shifting the needle holder.

c. **Purse-String Suture.** Pass this suture to the surgeon on a needle holder as described in paragraph "b" above. The purse-string suture is a fine silk suture, always prepared dry.

d. **Peritoneal Suture.** Pass the suture on a needle holder as previously described (paragraph "b" above) and give the end of the suture to the assistant, who will hold it in order that it will not hang over the edge of the sterile field and become contaminated. Pass a dressing forceps to the surgeon in his other hand, which he uses to hold the peritoneum together while suturing.

e. **Interrupted Sutures for Muscle and Fascia.** Pass the suture that is used for the muscle and fascia to the surgeon on a Murphy needle in the usual manner (paragraph "b" above). To save time and material, cut the remaining peritoneal suture and use it for these interrupted sutures (when the same suture material is used for all of these tissues). In order to keep the surgeon supplied with interrupted sutures, keep one suture ahead of the surgeon because when the surgeon finishes placing a suture, the next one should be ready. Since speed is essential in this procedure, you should practice until able to perform the procedure rapidly and accurately.

f. **Interrupted Sutures for Subcutaneous Tissue.** Pass these sutures to the surgeon on Murphy needles as described above. Usually, the suture for subcutaneous tissue is the same as that used for ties. Whenever this is the case, suture left over from the ties is utilized here.

g. **Interrupted Sutures for Skin Closure.** When passing the silk suture on a Keith (straight cutting) needle to the surgeon, also hand him an Adson forceps with which to hold the skin edges. Prepare the skin sutures so that as the surgeon finishes placing one suture, another is ready for him, as with any other type of interrupted suture. Be careful in passing this suture in order that the point of the Keith needle does not pierce or tear the surgeon's glove. Hand the needle with its eye toward the surgeon. A good technique is to place three Keith needles on a folded towel with the points of the needle placed through a thread in the towel. When the surgeon places a suture, he returns the needle to the towel.

h. **Metal Clips for Skin Closure.** Although silk is usually used for closing the skin, the surgeon may prefer to use skin clips. The clips used for this purpose are Michel clips (small metal clips with prongs at either end). Prepare the clips for use by stringing several clips on a piece of wire that serves as a holder. Cut off the ends of this wire holder to facilitate picking up the clips with the applier. The surgeon applies the clips by means of an instrument, which holds them and squeezes them so that the prongs go into the skin and the clip is bent into a "U" shape. The surgeon uses tissue forceps to pull the skin in approximation while applying the clips. Stabilize the clip holder on an unbroken tube of suture in order that the surgeon may grasp the clips more easily.

i. **Tension Sutures.**

(1) Wire. When a wire tension suture is required, thread the wire through a heavy, large, curved, cutting-edge needle at least 3 1/2 inches long. Avoid kinking the wire while threading it, and thread rubber shods (see para 2-6d) over the wire to prevent it from cutting into the skin. Clamp a hemostat on the long end of the wire to keep the rubber shods from slipping off prior to and during use. Carefully bend, but never twist, the short end of the suture, as this would place too much bulk at the needle's eye. No more than 3 or 4 of these sutures are needed for an incision 8 or 9 inches long.

(a) The surgeon usually places tension sutures before he sutures any of the layers of tissue. Pass this suture to the surgeon along with the tissue forceps, and hand the hemostat on the long end of the wire to the assistant for handling.

(b) Tension sutures are not tied until the skin closure has been completed. When the wire is ready to be tied, pass scissors used only for cutting wire to the assistant. Do not pass the suture scissors for this purpose, as the wire would dull them. The assistant cuts the sutures after they have been tied by the surgeon.

(2) Silk. When silk is used for a stay or tension suture, a heavy size such as number two is used. It is prepared at least 28 inches long. Using the fingers, thread this silk through two holes of a button from the bottom upward, across the top of the button and downward again. The button will then be hanging in the middle of the suture

so that when the ends are brought together the smooth (concave) surface of the bottom will be toward the ends of the suture. Grasp both ends of the silk between the fingers, and thread them both simultaneously through the needle eye, as though a single strand. Allow a tail about 4 inches long to hang free.

(a) The surgeon inserts this suture approximately 1 1/4 inches from the edge of the incision and, when he pulls it through, places the button against the patient's skin.

(b) When the surgeon is ready to tie this suture, hand the second button to his assistant, who threads it with the free ends of suture on the opposite side of the incision. The knot is tied over the second button. This suture does not cross the incisional line on the skin surface.

j. **Summary.** The skill of assisting with the aseptic procedure of suturing is developed through practice and experience, but it is imperative that amounts and kinds of suture be determined before starting an operative procedure, to avoid waste of time and materials. Suture is expensive and must be handled accordingly. Suture cards must be checked frequently and maintained in detail, if they are to be effective are a useful guide in the preparation of sutures for a surgical procedure. Proficiency in the handling of suture material can and must be developed by the OR specialist.

Section III. PREPARATION OF SPECIMENS

2-11. HANDLING OF SPECIMENS

The care and handling of specimens in an OR and between the surgical suite and the laboratory is an extremely important and sensitive procedure. It reflects upon not only the safety of the patient but also the efficiency of the operating team.

a. **Kind of Tissue Examined.** A specimen is defined as anything surgically removed from the patient; it may be bone, soft tissue, or foreign bodies. Any tissue removed during a surgical procedure is examined for pathology unless the surgeon specifically orders otherwise. Both the scrub and the circulator have certain duties in the processing of specimens for the laboratory. Specimens are usually sent to the laboratory for routine examination, but they may also be processed for tuberculosis organisms or as frozen sections. In addition, most specimens must be handled using sterile technique to preclude the introduction of new bacteria.

b. **General Considerations.** Some general considerations must be taken into account when working with specimens. They follow:

(1) Specimen for identification. Some specimens are for identification. Examples of these are the appendix, hernia sac, veins, and tonsil tissue. In these instances, the surgeon knows, in advance of surgery, the condition of the patient. Through surgery, he will remove an organ or part that is diseased or endangering the

patient's health. The specimen is sent to the laboratory, where it is identified and pertinent information recorded in the patient's medical records by the pathologist. An example is a vein and the location from which it is removed, especially specimens that are located bilaterally in the body.

(2) Specimen for diagnosis. Sometimes the surgeon does not know in advance, what is causing the patient's symptoms. Through the results of diagnostic tests, which will be done on the specimen in the lab, the surgeon will form a diagnosis. When the diagnosis is made, he will determine the best way of treating the patient. Two examples of this type of specimen are a breast biopsy and a fluid deposit within the body.

(3) Legal significance of specimen. Keep in mind the legal significance of any specimen. A lawsuit may result from a specimen mislaid or otherwise handled improperly. Legal action other than a suit may involve a specimen such as a bullet in a criminal case.

c. **Routine Specimens.** Different types of specimens may be handled in different ways; however, most specimens are handled in the routine manner including those for identification (b(1) above) where no great speed is necessary. Following are the duties of the scrub and circulator regarding the routine handling of specimens.

(1) Duty of scrub. The scrub keeps the specimen in his care until he gets permission from the surgeon to hand it "off," (using an instrument), to the circulator. The scrub verifies the kind of specimen (tissue) with the surgeon and informs the circulator.

(2) Duty of circulator. The circulator does the following:

(a) Receives the specimen from the scrub.

(b) Verifies the kind of tissue to be used by asking the surgeon. He makes no assumption as to what tissue to use.

(c) Selects the correct size lidded container, usually a jar, large enough where the specimen will not be damaged, and ten percent formalin can be added to cover the specimen.

NOTE: Check with the surgeon before placing the specimen in formalin. If the specimen is to be photographed, it is not placed in formalin since it may become discolored.

(d) Places a specimen to be photographed in a corrosion resistant steel (CRS) basin covered with a moist towel or with normal saline solution.

(e) Identifies the specimens on all proper forms. A separate container is used for each specimen, but several specimens from the same patient can be listed on one SF 515 (Tissue Examination) (see figure 2-8). In addition to other information (para (f) below), a number should be placed on the label of each specimen container. A corresponding number must go on SF 515 with the correct specimen description. Local policy may provide additional guidance.

(f) Prepares labels for all specimens. Write on each label the date of operation, the patient's name (last name, first name, and middle initial), ward number, hospital register number, social security account number, the surgeon's name, and the kind of specimen. If the patient's hospital identification has been stamped at the bottom of SF 515, the circulator may not be required to fill in the patient's name in the blank space provided, depending again on the local policy. At the bottom of the page, he fills in the spaces labeled age, sex, race, identification number, register number, and ward number (see figure 2-8).

(g) Records each specimen in the OR specimen book. The specimen is then placed in the designated area in the workroom. The circulator or designated person obtains the laboratory specialist's signature in the specimen book for each specimen he receives.

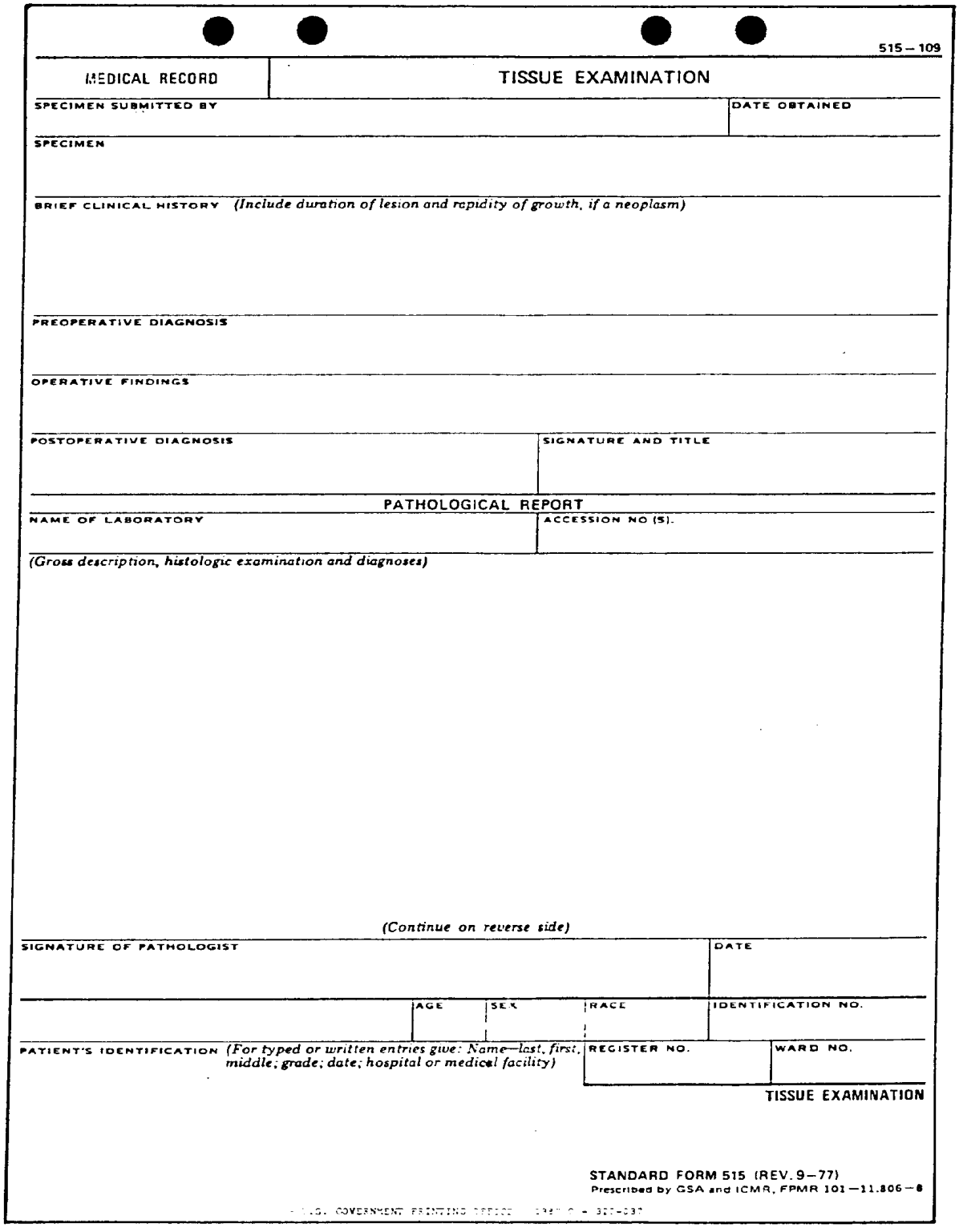
d. **Specimens to be Examined for Tuberculosis Organisms.** These specimens are prepared and labeled as described above, except that the specimen is covered with normal saline or a moist towel instead of formalin.

e. **Frozen Sections.** There is also a routine procedure to be followed for frozen section specimens. A frozen section is exactly what the name implies.

(1) The specimen is quickly frozen so that extremely thin slices or sections can be made. These then are examined by the laboratory personnel for signs of malignant conditions. Usually this procedure is noted on the operation schedule. The laboratory should be notified in advance to prepare for a frozen section.

(2) When the patient arrives in the OR, the specialist should obtain the necessary form from the patient's chart and complete the label, specifying "Frozen Section." The scrub hands the specimen in a moist, folded hand towel to the circulator. As with other specimens, it is recorded in the specimen book and must be signed for by the laboratory specialist.

(3) It is taken to the laboratory immediately for examination and report. Usually the report of laboratory findings is available in 10 minutes. If the report is negative, then the surgical procedure will be completed. If the report is positive, then a more radical surgical procedure may be instituted. Therefore, accuracy in relaying information is paramount.



515–109

MEDICAL RECORD | TISSUE EXAMINATION

SPECIMEN SUBMITTED BY | DATE OBTAINED

SPECIMEN

BRIEF CLINICAL HISTORY *(Include duration of lesion and rapidity of growth, if a neoplasm)*

PREOPERATIVE DIAGNOSIS

OPERATIVE FINDINGS

POSTOPERATIVE DIAGNOSIS | SIGNATURE AND TITLE

PATHOLOGICAL REPORT

NAME OF LABORATORY | ACCESSION NO (S).

(Gross description, histologic examination and diagnoses)

(Continue on reverse side)

SIGNATURE OF PATHOLOGIST | DATE

AGE | SEX | RACE | IDENTIFICATION NO.

PATIENT'S IDENTIFICATION *(For typed or written entries give: Name—last, first, middle; grade; date; hospital or medical facility)* | REGISTER NO. | WARD NO.

TISSUE EXAMINATION

STANDARD FORM 515 (REV. 9–77)
Prescribed by GSA and ICMR, FPMR 101—11.806—8

U.S. GOVERNMENT PRINTING OFFICE

Figure 2-8. SF 515 (Tissue Examination).

2-12. HANDLING OF CULTURES

a. **The Surgeon.** The surgeon determines whether a culture will be done and, if done, he specifies the laboratory test to be performed.

b. **The Specialist.** The specialist performs certain duties in the processing of a specimen for culture as follows:

(1) Have the desired number of sterile culture tubes ready and available to the surgeon.

(2) Prepare a label as described in paragraph 2-11c(2)e.

(3) Prepare the appropriate laboratory form and indicate the test(s) that the surgeon orders done.

(a) If SF 557 (Miscellaneous form) (see figure 2-9) is not filled out when it comes to the OR on the chart with the patient, it is the circulator's duty to fill in the required information.

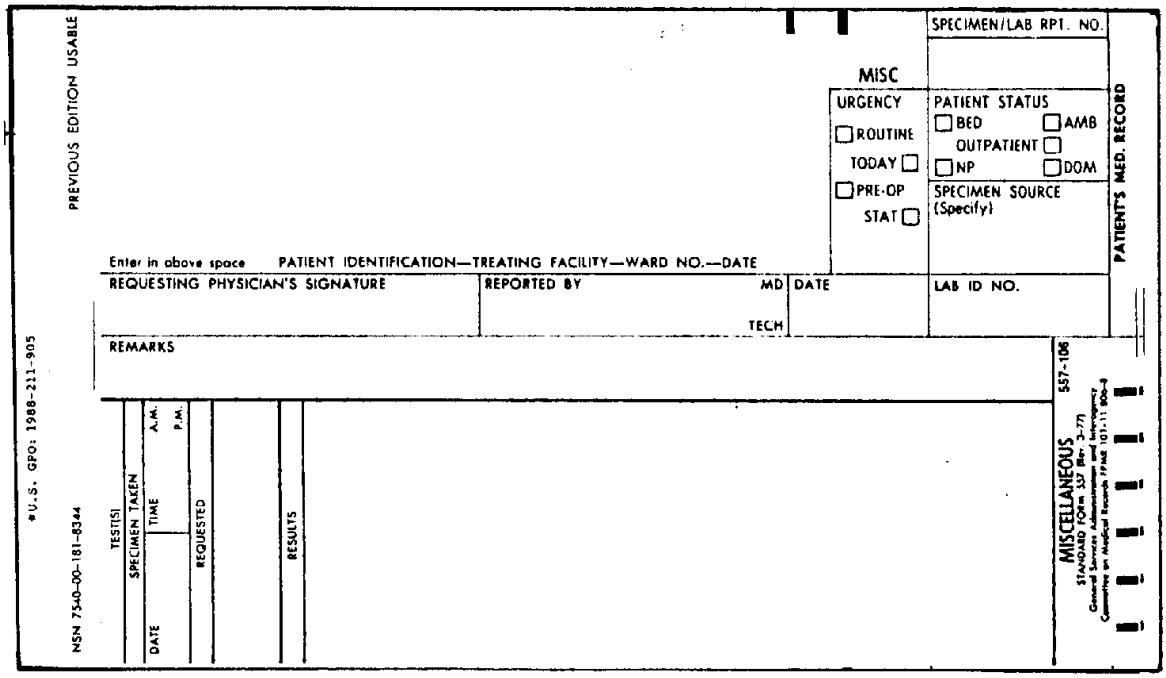


Figure 2-9. SF 577 (Miscellaneous form).

(b) The circulator should fill in all information on this form except the spaces labeled results, date of report, signature, and name of medical facility. In the space marked "Examination Requested," he will usually write "C & S" for "culture and sensitivity." This means that the growth should be exposed in the lab to various antibiotics to see which will kill the organisms. The surgeon then uses this information to treat the patient. SF 557 is attached to the culture tube and sent to the lab.

(4) Mark the labels numbers 1, 2, and so on when multiple specimens are obtained.

(5) Exercise care in handling the specimen. Even when the specimen does not look purulent, handle it as though it is from an infected area. By following this principle, you will avoid contaminating either yourself or the OR. If the culture tube with culture is broken, notify the surgeon at once. The area in which the tube broke should be considered septic since infectious bacteria may have been in the culture.

(6) Avoid contaminating the specimen. The entrance of outside contaminants makes a culture worthless.

(7) Record the specimen in the book and see that it gets to the laboratory as soon as is practicable. The material in the culture tube must not be allowed to dry because drying kills bacteria. A liquid transport medium, if available, may be used to ensure that any microorganisms present do not die by drying before a medium can be streaked with the sample. The laboratory specialist signs the specimen book for the culture.

2-13. TISSUE TO BE PROCESSED FOR STORAGE

a. **Tissue "Banks."** Certain hospitals have facilities for the preservation and storage of various types of tissue. When tissue to be stored in a "bank" is excised, it is handled in accordance with the local policy. The tissues most commonly stored in a "bank" are: skin, bone, cartilage, and blood vessels.

b. **Sources of Tissue.** Subject to conditions prescribed by local policy, tissue may be obtained from the following sources:

(1) A patient who has had the desired tissue excised during a scheduled surgical procedure.

(2) A voluntary donor.

(3) A cadaver.

c. **Laboratory Tests.** Cultures of the specimens are done in accordance with local policy.

d. **Sterile Procedure.** Sterility must be maintained throughout the procedure of removing and processing the specimen.

e. **The Specialist.** The specialist has duties similar to those described for the processing of specimens for pathologic examination. He is to do the following:

(1) Have ready any sterile items needed (culture tubes, petri dishes, or jars).
(2) Prepare the necessary forms for the laboratory.

(3) Enter the name of the donor, date of excision, and other required information on the appropriate card or tag (for identification of the tissue).

(4) Perform other duties as indicated by local policy.

Continue with Exercises

EXERCISES, LESSON 2

INSTRUCTIONS. Answer the following exercises by marking the lettered response that best answers the question or best completes the incomplete statement or by writing the answer in the space provided.

After you have completed all of these exercises, turn to "Solutions to Exercises" at the end of the lesson and check your answers. For each exercise answered incorrectly, reread the material referenced with the solution.

1. For the correct processing of a specimen for frozen section, how should the scrub hand the specimen to the circulator?

   a. Wrapped in a moist, folded hand towel.

   b. Covered with a vaseline gauze sponge wrapped in a folded hand towel.

   c. Covered with normal saline in a CRS basin wrapped in a folded hand towel.

   d. Covered with normal saline in a lidded container and wrapped in a folded hand towel.

2. Suture that is used to stitch a vessel wall and tie around the vessel is called

   a. Purse-string stitch.

   b. Tension stitch.

   c. Stick-tie.

   d. Ligature.

3. Standard prepackaged silk suture is supplied in a length of _____ inches.

   a. 30.

   b. 35.

   c. 55.

   d. 65.

4. You (the scrub) should use care when threading a French (spring) eye needle because:

   a. The suture slips out easily.

   b. This needle is difficult to thread.

   c. The eye of the needle is hard to see.

   d. The eye of the needle is easily broken.

SITUATION for exercises 5 and 6. The surgeon has removed a patient's gallbladder, and has directed that the specimen be photographed before being sent to the laboratory for routine examination. You (the circulator) have just received the specimen from the scrub.

5. What should you use as a container for the specimen?

   a. Towel.

   b. CRS basin.

   c. Lidded jar.

   d. Gauze sponge.

6. What solution should you cover the specimen with until it is photographed?

   a. Formalin ten percent.

   b. Normal saline.

   c. Chromium salt five percent.

   d. Disinfectant solution.

For exercises 7 through 11. Match the information in **Column A** to the items listed in **Column B**. You may use the items in **Column B** more than once.

COLUMN A

Characteristics of Wound

_ 7. The surgeon sutures a wound four days following debridement.

_ 8. A noninfected wound is closed with sutures.

_ 9. A ten-day-old wound is badly infected, the surgeon treats it and leaves it open to heal.

_10. A gross amount of damaged tissue is excised, suturing is not done until a week later.

_11. A narrow, linear scar is the result of this.

COLUMN B

Method of Healing

a. By primary intention.

b. By secondary intention.

c. By third intention.

For exercises 12 through 17. Match the information in **Column A** to the items listed in **Column B**. You may use the items in **Column B** more than once.

COLUMN A	**COLUMN B**
Descriptive Characteristics	**Kinds of Suture Materials**
__12. Suture used for slow healing.	a. Chromic gut.
__13. Suture that the body enzymes do not digest.	b. Plain gut.
__14. Suture needed for support for a longer period.	c. Silk suture.
__15. Suture that is used primarily in clean surgery.	
__16. Suture that is absorbed slowly.	
__17. Suture that is absorbed quickly.	

For exercises 18 through 25. Match the information in **Column A** to the items listed in **Column B**. You may use the items in **Column B** more than once.

COLUMN A	**COLUMN B**
Characteristics of Stitches	**Type of Stitch**
__18. Special protective devices for the skin are used when this stitch is placed.	a. Purse-string stitch.
__19. Heavy, nonabsorbable suture is used for this stitch.	b. Tension (retention or stay) stitch.
__20. When tightened, this stitch closes a hollow structure.	c. Subcuticular stitch.
__21. A stitching technique for approximating the skin without a visible suture line.	d. Interrupted stitch.
__22. A stitch that is tied individually.	
__23. A continuous stitch placed around the lumen of a structure.	
__24. Each stitch is taken with a separate piece of suture, often used for primary closure of various tissues.	
__25. A short running stitch taken inside the incision and placed in the dermis.	

SITUATION for exercises 26 and 27. The surgeon performs an appendectomy and directs you (the circulator) to send the appendix to the laboratory for routine examination.

26. Which of the following items should be used to hold the specimen?

    a. Towel.

    b. CRS basin.

    c. Lidded jar.

    d. Gauze sponge.

27. If necessary, you should place the specimen in _____.

    a. Chromium salt five percent.

    b. Normal saline.

    c. Formalin ten percent.

    d. None of the above solutions.

Check Your Answers on Next Page

SOLUTIONS TO EXERCISES, LESSON 2

1. a (para 2-11e(2))
2. c (para 2-3f)
3. a (paras 2-3c(1)(a) and 2-9c)
4. d (para 2-9d)
5. b (para 2-11c(2)(d))
6. b (para 2-11c(2)(d))
7. c (para 2-4c)
8. a (para 2-4a)
9. b (para 2-4b)
10. c (para 2-4c)
11. a (para 2-4a)
12. a (para 2-3b(2))
13. c (para 2-3c, 2-6d)
14. a (para 2-3b(2))
15. c (para 2-3c(1))
16. a (para 2-3b(2))
17. b (para 2-3b(1))
18. b (para 2-6d, figure 2-2 D)
19. b (para 2-6d, figure 2-2 D)
20. a (para 2-6c, figure 2-2 C)
21. c (para 2-6e, figure 2-2 E)
22. d (para 2-6b, figure 2-2 B)

23. a (para 2-6c, figure 2-2 C)

24. d (para 2-6b, figure 2-2 B)

25. c (para 2-6e, figure 2-2 E)

26. c (para 2-11c(2)(c))

27. c (para 2-11c(2)(c))

End of Lesson 2

LESSON ASSIGNMENT

LESSON 3	Procedures in Anesthesia and Parenteral Therapy.
LESSON ASSIGNMENT	Paragraphs 3-1 through 3-50.
LESSON OBJECTIVES	After completing this lesson, you should be able to:

3-1. Define common terms used in anesthesia.

3-2. Identify methods of administering anesthesia (regional and general) and the procedures for each method.

3-3. Identify the four stages of general anesthesia.

3-4. Identify common anesthesia agents and the characteristics of each.

3-5. Identify medical emergencies connected with anesthesia, to include their cause and management.

3-6. Identify procedures for administering injections, intravenous infusions, transfusions, and for withdrawing blood.

SUGGESTION After completing the assignment, complete the exercises at the end of this lesson. These exercises will help you to achieve the lesson objectives.

LESSON 3

PROCEDURES IN ANESTHESIA AND PARENTERAL THERAPY

Section I. INTRODUCTION

3-1. GENERAL

a. **Applicability to Specialist.** Almost every procedure performed on patients in the OR requires the administration of some type of anesthetic. The duties of the OR specialist include assisting with the administration of both local and general anesthetic agents. Therefore, the specialist should have a working knowledge of the basic agents, their toxic effects, and the precautions to be taken with the use of each of these anesthetic agents. The specialist must know his duties in assisting with the administration of the various agents. The object of this lesson, then, is to present material that will help the specialist to attain or refresh such knowledge.

b. **Agents Discussed.** The anesthetic agents considered here are those standard drugs capable of producing anesthesia of a depth and for a sufficient period that the patient may remain free from pain throughout the surgical procedure.

3-2. TERMINOLOGY

a. **Analgesia.** A state in which the perception of pain is lost or dulled without loss of consciousness or the sense of touch.

b. **Analgesic.** A drug that produces analgesia.

c. **Anesthesia.** A bodily state in which sensation is absent.

d. **Anesthetic.** An agent that produces anesthesia. A state of anesthesia is deliberately induced through the use of an anesthetic agent when a surgeon is to perform an operation.

(1) Regional (local) anesthetic. Regional anesthetic agents exert their effect by blocking the transmission of nerve impulses without producing loss of consciousness.

(2) General anesthetic. General anesthetic agents exert their effect by producing loss of all modalities of sensation, including loss of consciousness.

(a) Induction is the period from the beginning of the administration of the anesthesia until the patient loses consciousness.

(b) Intubation is the introduction of an endotracheal tube (see figure 3-1) into the larynx through the nose or mouth, usually done after the patient is under the influence of a general anesthetic.

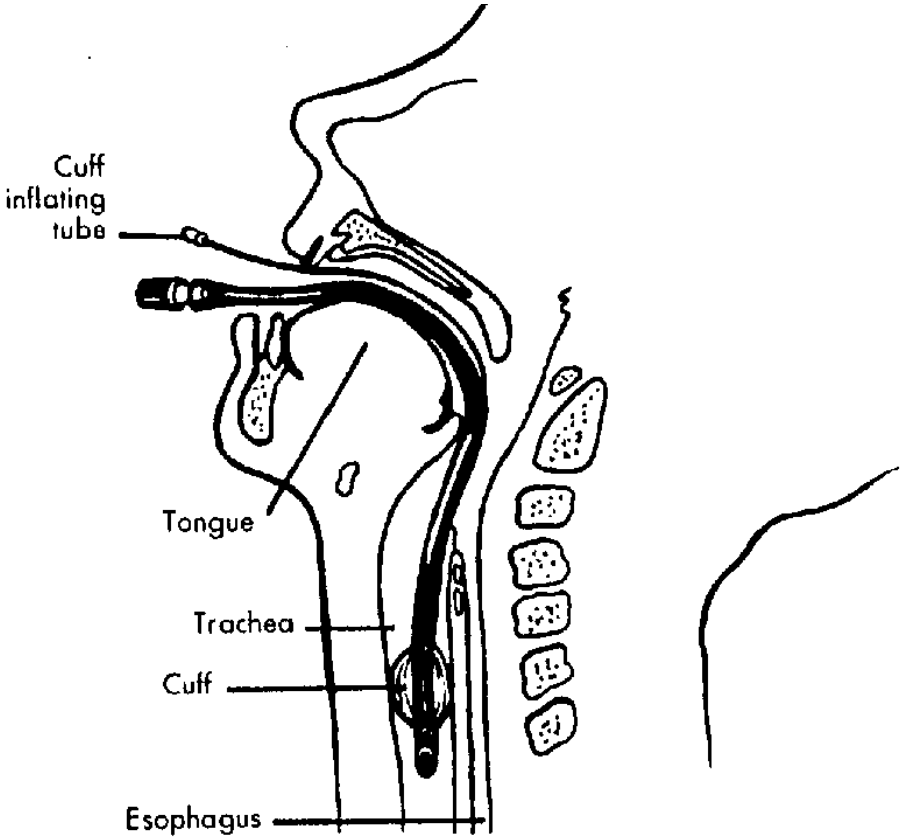


Figure 3-1. Endotracheal tube.

(c) Extubation is removal of the endotracheal tube (with or without replacement by an airway) when the operation is finished.

e. **Toxicity.** The toxicity of a drug is the least amount of it (in a certain concentration) necessary to produce symptoms of over dosage (toxic reaction) when given to a person in ordinary health.

f. **Toxic Reactions to Drugs.** Either of the reactions described below is potentially dangerous to the patient.

(1) Idiosyncrasy. Idiosyncrasy is an abnormal response to a drug, manifested in the patient by a reaction much greater than that anticipated or of an unusual type. Examples of such reactions are seen in the occasional patient who sleeps for 24 hours or longer following an average dose of a barbiturate or in the patient who becomes excited following an injection of morphine. The majority of reactions to anesthetic agents are due to idiosyncrasy.

(2) Hypersensitivity. Hypersensitivity (or sensitivity) is an allergic reaction to a drug. Hypersensitivity may be manifested by skin rash, urticaria (eruptions of itchy patches of skin), angioneurotic edema (nervous disorder affecting blood vessels attended by swelling), drug fever, damage to certain organs, rhinitis (inflammation of nasal mucous membrane), asthma, or anaphylactic shock. A drug need not be highly toxic for an allergic reaction to result. Drugs of low toxicity may give rise to an allergic response. Hypersensitivity reactions (especially anaphylactic shock) are usually more difficult to manage than are reactions caused by idiosyncrasy. Fortunately, hypersensitivity reactions do not usually occur with most drugs, including anesthetic agents.

3-3. THE ANESTHETIST AND THE SPECIALIST

a. **The Anesthetist.** He is as much a part of the surgical team as is the surgeon himself. The specialist serving as the circulator should render assistance to him accordingly. The anesthetist, particularly when administering general anesthesia, controls the patient's vital life processes of respiration and circulation.

b. **The Specialist.** To perform effectively, the specialist must understand the fears of the patient awaiting anesthesia and the principles of supporting the anesthetist with each type of anesthetic agent used.

(1) Fears of the patient. The specialist should respect any fears that the patient exhibits in relation to his pending anesthesia and surgery. Such fears should not be ridiculed by telling him "Oh, you will be all right;" or "We do hundreds of these a year and nothing happens," as if he were just a routine encounter for the day. The patient may need further explanation by the surgeon, anesthetist, or OR supervisor to alleviate or minimize his fears. The specialist can allay the patient's fears by his actions. The following guidance is appropriate:

(a) Show respect for and acceptance of the patient as an individual.

(b) Display skill and quiet confidence.

(c) Do not discuss the patient's condition.

(d) Do not leave the patient alone unless properly relieved.

(2) Principles of supporting the anesthetist. The specialist provides maximum support to the anesthetist by knowing what procedure the anesthetist will follow when administering anesthetic agents and by performing his own duties skillfully and accurately.

3-4. PREANESTHETIC MEDICATION

Administration of preanesthetic medication is a procedure that helps the patient, both mentally and physically for the ensuing operation. It is designed to make anesthesia smoother and safer.

a. **Effects on Patient.** The preanesthetic medication the patient receives usually affects his behavior. The OR specialist should understand that the patient may be drowsy, slow to respond, poorly coordinated and thirsty. The patient may wish to cooperate, but he needs sufficient time and explanation to do what is expected of him.

b. **Preanesthetic Drugs Commonly Used.** A brief discussion of preanesthetic drugs commonly used, their purpose, and the probable time they are administered follows:

(1) Secobarbital and pentobarbital. The barbiturates, secobarbital and pentobarbital, are oral sedatives given the night before and the morning of surgery. They and the opiates tend to allay the anxiety and apprehension of the patient and to lower the metabolic rate, thus reducing the amount of anesthetic necessary.

(2) Morphine and meperidine. The opiates, morphine and meperidine, are combined with a belladonna derivative, such as atropine or scopolamine and given as a sterile injection 45 to 90 minutes prior to surgery.

(3) Atropine and scopolamine. These belladonna derivatives, when used, tend to reduce the amount of secretions in the mouth and respiratory tract and, thereby, help to maintain a patent airway. They tend also to reduce certain harmful reflexes that may occur during the operation.

3-5. FACTORS IN SELECTION OF ANESTHETIC AGENT

The surgeon, in collaboration with the anesthetist and the patient, determines the choice of anesthetic agent.

a. Some factors that are considered in making a choice include the following:

(1) Age of the patient.

(2) Condition and size of the patient.

(3) Nature and length of operative procedure.

(4) Pharmacologic effects of the drug used.

b. Consideration is given to the above and other factors to ensure maximum safety of the patient, a workable field for the surgeon, and a manageable depth of anesthesia for the anesthetist.

Section II. REGIONAL ANESTHESIA

3-6. METHODS OF ADMINISTRATION

Following are various methods of administering regional (local) anesthetic agents. A detailed discussion of each follows in the next few paragraphs. Some of the most common regional anesthetic agents are discussed in paragraphs 3-13 through 3-15.

a. **Local Infiltration**. Local infiltration is the administration of an anesthetic agent by infiltrating (injecting) the drug into the tissue surrounding the operative area.

b. **Topical Application**. Local application is the application of the drug on a membranous surface in the operative area.

c. **Regional Nerve Block**. A regional nerve block is done by injecting an agent into or around the nerve or nerves supplying the area involved.

d. **Spinal (Subarachnoid) Block**. A spinal block is done by injecting an agent into the subarachnoid area by inserting the needle through an interspace in the lumbar vertebra.

e. **Peridural (Caudal) Block**. A peridural block is done by injecting an agent through a foramen in the sacrum into the sacral canal in the space surrounding the dura mater.

3-7. ADMINISTRATION OF LOCAL INFILTRATION ANESTHESIA

a. **Procedure.** Since the anesthetic is to be injected into the patient, the preparation is a sterile procedure. When the preparation is complete, including preparing and draping the patient, the surgeon acts as the anesthetist, and the circulator and the scrub assist him as indicated below:

(1) The circulator opens the local set and hands it to the scrub.

(2) The scrub checks the medicine glass in the local set. If the glasses contain a residue, he discards them to the circulator and asks for fresh glasses. The addition of excess alkali (such as the residue of certain cleaning solutions) to solutions of local anesthetics may cause precipitation of the anesthetic base and result in loss of potency of the solution.

(3) The circulator assists the patient on the OR table, then places the patient in the position desired by the surgeon. Frequently, the patient's position for the local infiltration anesthesia is the position for surgery, but if the position for surgery is to be different, the circulator positions the patient when the surgeon instructs him to do so.

(4) The circulator checks the label on the bottle of anesthetic solution, then holds it in such a way that the surgeon and the scrub can also read it. Both the circulator and the scrub observe the solution. If necessary, the circulator discards the vial and gets a fresh one.

(5) The circulator cleanses the rubber stopper with an alcohol sponge and holds the vial of solution in order to allow the scrub to withdraw a sufficient quantity of solution if the amount to be used is 5 to 10 ml. (Circulator places index and middle fingers of both hands across the shoulders of the vial, supports bottom of vial with his thumbs, and tilts downward at an angle sufficient that solution can be withdrawn, but with stopper of vial facing toward the scrub.)

(6) If a whole vial or more of anesthetic solution is to be used, the circulator removes the top completely (without contaminating the mouth of the vial) and pours the solution into a sterile medicine glass, from which the scrub draws it into the syringes.

(7) The surgeon frequently orders epinephrine added to the anesthetic solution. When epinephrine (adrenalin) is ordered, the circulator gives the scrub a sterile 20-gauge needle and a sterile tuberculin or insulin syringe.

(8) The circulator removes the top from an ampule (1 ml) of epinephrine (after wiping it with an alcohol sponge), then he holds it tilted slightly toward the scrub.

(9) The scrub withdraws the exact prescribed dosage of epinephrine from the ampule, using syringe and needle. He then expels the prescribed amount into the anesthetic solution. The two must be thoroughly mixed.

(10) The scrub has ready for the surgeon the items necessary for the skin preparation, and the surgeon prepares the patient's skin. When the solution used for the preparation dries, the scrub and the surgeon drape the patient.

(11) The scrub hands equipment to the surgeon in the order of its use. The first needle the surgeon uses is the smallest gauge needle, to avoid causing discomfort to the patient while making a wheal. After he injects the skin, he uses a needle long enough to reach the deepest area desired. The scrub keeps the alternate 10 ml Luer control syringe filled. The use of two syringes enables the surgeon to switch quickly from an empty one without waiting while the scrub refills it. The surgeon may leave the needle in place and exchange only the syringe.

b. **The Surgeon.** In some cases the surgeon may desire to position the patient or to place the sterile drapes unassisted by the specialist. When the surgeon wishes to perform these procedures himself, he will so inform the circulator and the scrub.

c. **Recording.** The circulator is responsible for making the appropriate entries (in ink) upon the record designated by local policy for that purpose. These entries include: the name of the operation performed; the position in which surgery was performed; the name, strength, and amount of anesthetic solution used (this information is especially important in the event that an emergency develops due to idiosyncrasy); and the surgeon's and anesthetist's name (usually one and the same). The circulator also enters the time when the anesthesia began, when surgery began, and when surgery ended. Anesthesia begins when the first injection is made (an accurate determination of the time when anesthesia ends cannot be made). Surgery begins at the time of the initial incision and ends with placement of the last suture.

3-8. TOPICAL APPLICATION OF ANESTHESIA

a. **General.** Topical anesthetic is achieved by applying the anesthetic agent to the surface of a membrane in the operative area. Surgeons may apply topical anesthesia as sprays, nasal packs, drops, or to have the patient gargle the anesthetic agent. In general, surgeons use topical anesthesia for eye, nose, and throat surgery prior to local infiltration of an anesthetic agent into the desired area.

b. **Procedure for Application of Spray.** Spraying the patient's throat (usually done for bronchoscopy and may be done for tonsillectomy) is an unsterile procedure performed by the surgeon, usually with the patient in a sitting position.

(1) The circulator prepares the proper equipment and has it ready for the surgeon. The setup listed below for spraying the throat contains items needed for the procedure. These are assembled on a tray or small portable table.

(a) Head mirror and light.

(b) Laryngeal mirrors, size 4/5.

(c) Tongue depressors.

(d) Facial tissues.

(e) Emesis basin.

(f) Cotton.

(g) Basin of sterile water.

(h) Prescribed solution of anesthetic agent in desired strengths.

(i) Three medicine glasses, labeled for use of topical drugs.

(j) Lukens syringe, with laryngeal tips.

(k) One Jackson cross-action forceps or one Schindler-type forceps.

(l) Hot water.

(m) Thiopental set, oxygen, and face mask for emergency use.

(2) The circulator hands items of equipment that the surgeon requests. Local procedure may require changes in the items listed.

(3) The patient may be asked to gargle some of the anesthetic following the spraying of his throat.

c. **Procedure for Application of Packs.** Preceding nasal operations, a topical anesthetic is used inside the patient's nose and is applied by using packs. When the patient's skin has been prepared and he is draped, the surgeon, wearing gloves, applies the packs.

(1) Since this is a sterile procedure, the scrub prepares the following sterile equipment on a tray:

(a) Nasal speculum.

(b) Bayonet forceps.

(c) Cotton or gauze nasal packs.

(d) Metal and cotton-tipped applicators.

(e) Medicine glass.

(2) The scrub checks the medicine glass for residue. The circulator fills the medicine glass with the prescribed anesthetic solution (usually tetracaine, one or two percent), but before doing so he shows the label to the surgeon. This is done as a double check to ensure that the drug is the one prescribed and is in the desired strength.

d. **Recording.** The circulator records topical anesthesia as explained for local infiltration anesthesia (see para 3-7c). The time the anesthetic began is marked as the time the topical was started.

3-9. ADMINISTRATION OF REGIONAL NERVE BLOCK ANESTHESIA

a. **Areas Anesthetized.** The peripheral nerves of the body may be anesthetized by this method. An example is the brachial block, in which the anesthetic solution is injected into the brachial plexus, producing anesthesia of the fingers, hand, lower arm, and part of the upper arm.

b. **Procedure by the Anesthetist.** Using a needle of sufficient length to penetrate to the depth of the nerve or nerves to be anesthetized, the anesthetist inserts the needle and infiltrates the area with the anesthetic agent. Both the angle and the depth of insertion of the needle depend upon the location of the nerve and the nature of structures overlying it (bone, blood vessels). The procedure is similar to a local infiltration, except that longer needles are necessary to reach the brachial nerves.

c. **Procedure by the Specialists.** The circulator and the scrub follow the procedure set forth for local infiltration anesthesia (see para 3-7).

d. **Additional Duty of Circulator.** Some regional blocks may require from 15 to 45 minutes to become effective, the average time being about 20 minutes. Therefore, patients who are scheduled for this type of anesthesia are brought to surgery sufficiently early. The circulator should report to the anesthetist as soon as the patient is in the OR suite, and ask the anesthetist if he desires any assistance.

3-10. ADMINISTRATION OF SPINAL (SUBARACHNOID) BLOCK ANESTHESIA

a. **Areas Anesthetized.** Areas of the body in which anesthesia results following spinal block anesthesia include: the lower abdomen, the perineal area (including the rectal area), and the legs.

b. **Use.** Spinal anesthetic may be used on patients in whom there is no question of circulatory imbalance and for operations restricted to the lower extremities or the lower genitourinary tract. The severely wounded tolerate this procedure poorly, and it is contraindicated in the presence of hemorrhage or shock.

c. **Precautions.** It is extremely important that all equipment used for spinal anesthesia be sterile to prevent infection.

d. **Single Injection Technique.** A single dosage of the anesthetic agent is instilled into the subarachnoid space. Depending upon the agent and the technique used, anesthesia is established in 5 to 15 minutes and usually lasts from 1 1/2 to 4 hours. Refer to paragraph 3-10f.

e. **Procedure by Circulator.** The circulator helps the patient assume the necessary position (see figures 1-14 and 1-15), as ordered by the anesthetist.

f. **Site of Injection.** See figure 3-2. This may vary, depending upon the preference of the anesthetist. Usually, a vertebrae interspace at the fourth lumbar vertebra (L-4) is chosen. Alternate sites are the second and third vertebral interspaces, L-2 and L-3. The procedure of placing the spinal needle into the subarachnoid space is referred to as a spinal tap, spinal puncture, or lumbar puncture.

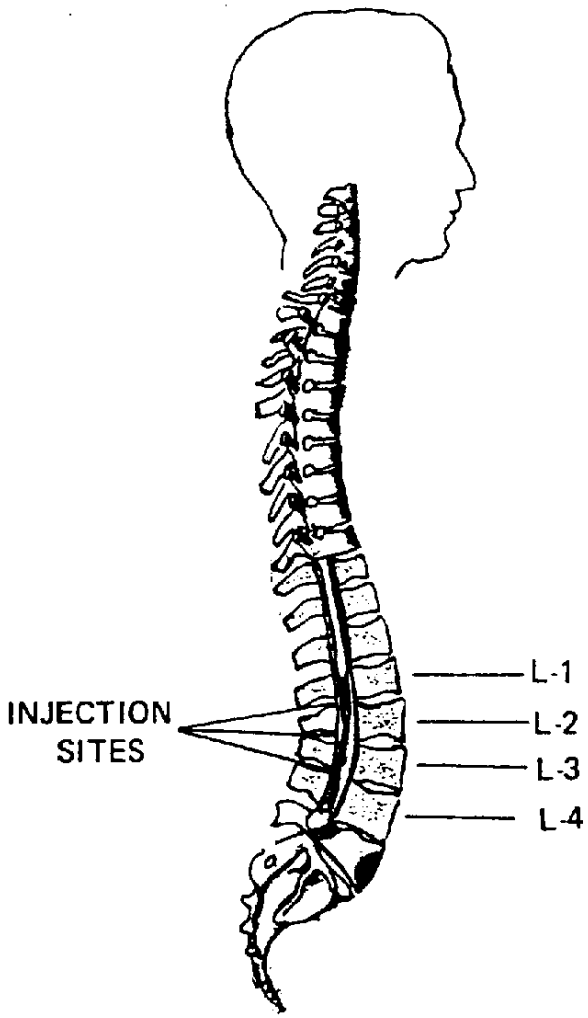


Figure 3-2. Injection sites for spinal anesthesia.

g. **Procedure by Anesthetist.** The anesthetist sets up his own spinal tray and puts a blood pressure cuff on the patient. He prepares the area chosen as the site of injection and drapes the area with sterile towels or a fenestrated spinal sheet. He then proceeds as follows:

(1) Injects a local anesthetic agent subcutaneously at the site selected.

(2) Inserts the spinal needle, with stylet in place at the vertebral interspace chosen (at a 90-degree angle to the skin). As it penetrates the dura mater covering the spinal canal, the needle will "give."

(3) Withdraws the stylet and allows a drop of spinal fluid to appear at the hub of the needle to confirm that the needle is in the subarachnoid space.

(4) Fits a syringe containing the anesthetic agent into the hub of the spinal needle; pulls back on the plunger to withdraw some spinal fluid and injects the anesthetic.

(5) Withdraws the syringe and the spinal needle with one movement.

(6) Regulates the tilt of the table to control the action of the agent used, after injection of the anesthetic solution. The circulator may be asked to do this under the direction of the anesthetist. To safeguard the patient against a dangerous drop in blood pressure, all movements made in altering the position should be executed smoothly and gently. After the anesthesia has become stabilized, the patient is properly positioned for surgery and the leg strap is secured.

h. **Management of the Patient.** The anesthetist may leave the room from time to time when a patient has had a spinal block, especially if the anesthetist is giving the same type of anesthetic in an adjoining room. If he does leave the room, the anesthetist may ask the circulator to check the patient's blood pressure while he is gone. The circulator should note his findings on a separate sheet of paper rather than on the anesthesia record and should report an unusually low or high reading immediately to the anesthetist. If the patient complains of pain, headache, nausea, or dizziness, the anesthetist must be notified immediately.

i. **Continuous Injection Technique.** This technique may be used whenever subarachnoid block anesthesia is indicated, and the single injection (see para 3-10d) will not produce anesthesia for a sufficient duration of time.

(1) Similarities to single injection technique. The injection site (see para 3-10f above), the patient's position (see para 3-10e above), and the adjustment of the table (see para 3-10g(6) above) are as previously discussed.

(2) Difference from single injection technique. The continuous technique is different in that the anesthetist instills the anesthetic solution intermittently throughout the operation (without disturbing the patient's position) by using special equipment (either a special needle to which a length of tubing is attached or a very small catheter, introduced through a large-bore spinal needle).

(3) Duties of the circulator. These are as described above for the single injection.

3-11. ADMINISTRATION OF PERIDURAL (CAUDAL) BLOCK ANESTHESIA)

a. **Use.** Peridural block produces anesthesia of the pelvic region. Therefore, peridural anesthesia may be used for surgical procedures involving the anus or the rectum, and for certain other procedures in the pelvic area where the surgeon's approach is extraperitoneal.

b. **Comparison with Spinal Block.** Local anesthetic agents are injected into the sacral canal in a similar manner to that described above, yet differing in several aspects.

(1) The anesthetist may induce peridural anesthesia by giving a single dose or by the continuous instillation of the anesthetic agent, as for spinal anesthesia (see para 3-10i).

(2) The anesthetist sets up the sterile tray as for a subarachnoid injection.

(3) The anesthetist adjusts the table after injection of the anesthetic agent as discussed for spinal anesthesia (see para 3-10g(6)).

(4) Management of the patient may be carried out as discussed above (see para 3-10h).

c. **Procedure by Circulator.** The procedure and positioning are as described above for spinal anesthesia. (Refer to para 3-10e; figures 1-14 and 1-15.) The anesthetist may wish to have the patient placed in the prone position (see figure 1-11) with a pillow placed under the iliac bones for administration of the anesthetic, rather than in the positions described for spinal anesthesia.

d. **Procedure by Anesthetist.** The anesthetist preps and drapes the patient as for spinal anesthesia, except that the gauze is placed between the gluteal folds before prepping for caudal anesthesia, in order that the prep solution will not run over the perineum and burn the patient. Next, the anesthetist injects a local anesthetic agent subcutaneously, as for spinal anesthesia (see figure 3-3). He then proceeds as follows:

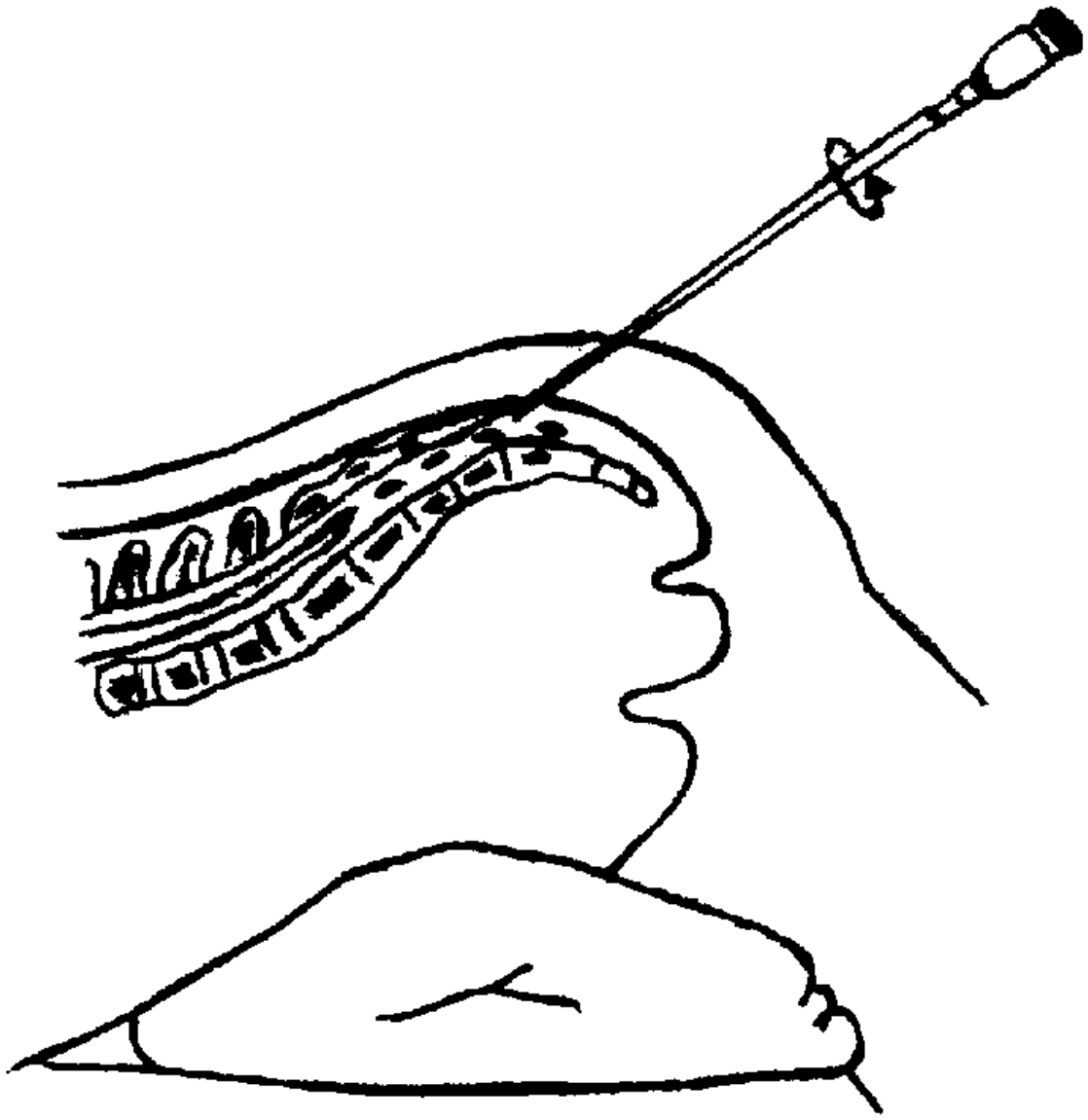


Figure 3-3. Site of injection for peridural (caudal) anesthesia.

(1) Instructs the patient to turn his toes in and his heels out in order to relax the gluteal muscles and to make it difficult for the patient to tense them.

(2) Inserts a standard spinal needle (3 1/2-inch, 18-gauge) through a sacral foramen at about a 10—20 degree angle to the skin.

(3) Checks to be sure that the needle is in the caudal canal by injecting air, so that, he can palpate in the tissues if the needle is not properly placed.

(4) Attaches a syringe and aspirates, when the needle is in place. If no blood or spinal fluid is obtained, injects 5 ml of the anesthetic solution, waits 5 minutes, tests the area of analgesia, and if satisfactory, injects another 5 ml of anesthetic and withdraws the needle.

(5) Chooses another method of anesthesia if blood or spinal fluid is aspirated, or if the area of analgesia is unsatisfactory after the initial injection of anesthetic.

3-12. REGIONAL ANESTHETIC AGENTS

Standard regional anesthetic agents in use include procaine hydrochloride, Nesacaine® lidocaine hydrochloride, and tetracaine hydrochloride. They are discussed in paragraphs 3-13 and 3-15 below.

3-13. PROCAINE HYDROCHLORIDE

a. **General.** Procaine Hydrochloride is an effective regional anesthetic when given by injection. It is not useful as a topical anesthetic because of its poor penetrating power, but is used to produce infiltration, nerve block, peridural, and spinal anesthesia. Generally, procaine is combined with epinephrine hydrochloride which delays absorption, prolongs anesthesia, reduces toxic effects, and promotes hemostasis.

(1) Toxicity. Procaine has been one of the least toxic of the injectable local anesthetics. However, there is now, a newer drug called Nesacaine®, which is still less toxic.

(2) Onset of action. The onset of operating analgesia is 5 to 15 minutes, and the duration, 45 to 90 minutes.

b. **How Supplied.** Procaine hydrochloride is supplied in various concentrations as sterile crystals prepared in ampules, as parenteral solutions prepared in both ampules and in bottles with rubber diaphragm closure, and in plastic collapsible tubes with needles attached.

c. **Precautions.** Care must be taken to observe proper technique, to avoid intravascular injection, and to have available facilities for combating overdosage.

d. **Toxic Reactions.** Both idiosyncrasy and sensitivity to this drug occur occasionally.

(1) Symptoms. Any of the manifestations discussed in paragraphs 3-2e(2) and 3-17a(1) may occur.

(2) Specialist's duties. These are as set forth in paragraphs 3- 18b and 3-19.

3-14. LIDOCAINE HYDROCHLORIDE

a. **General.** Lidocaine hydrochloride, known commercially as "Xylocaine®," is a potent local anesthetic agent which produces a prompt (5 to 15 minutes for the onset of operating analgesia), intense and extensive anesthesia which lasts about twice as long

as procaine. Its anesthetic potency and area of anesthesia are greater than those of procaine hydrochloride. At a concentration of 0.5 percent, lidocaine has approximately the same toxicity as does procaine, but as the concentration of lidocaine is increased, its toxicity exceeds that of procaine. In addition, lidocaine diffuses rapidly, a property that may increase the incidence of systemic reactions.

b. **Uses of Lidocaine Hydrochloride.** This agent is useful for topical, infiltration, and nerve block anesthesia. Lidocaine is also used for peridural block anesthesia, its effect lasting from 1 1/2 to 3 hours with low dosage. This agent is often used in individuals sensitive to procaine. The drug is administered according to the type of local anesthesia to be induced. The onset of mucosal anesthesia may be from 5 to 15 minutes. The jelly form of the drug may be applied by means of cotton pledgets or applicators to the mucous membrane or the oral cavity or the urethra. An ointment of the drug is used topically in treatment of burns and abrasions, as well as for dermatological, anorectal, and otological (concerning the ear) conditions.

c. **How Supplied.** Standard items of this drug are parenteral solutions in various strengths with and without epinephrine hydrochloride, as well as a jelly and an ointment.

d. **Precaution.** The specialist assisting the surgeon should <u>not</u> withdraw commercially- prepared lidocaine-epinephrine ahead of time. This drug should be injected immediately upon its withdrawal from the vial.

e. **Toxic Reactions.** These are not usual, but certain signs may occur when an excess of the drug is given.

(1) <u>Symptoms</u>. These manifestations, when the drug is absorbed slowly, are: a drowsy, sleepy state with some disorientation or amnesia. When excess is absorbed rapidly, convulsions may occur. The surgeon observes the patient carefully for an untoward reaction and maintains verbal contact with patient in order to know the patient's mental status throughout the procedure.

(2) <u>Specialist's duties</u>.

(a) Have the items set forth as in paragraph 3-19 in the room, ready for immediate use.

(b) Move the anesthetist's machine near the surgeon, and leave the room to obtain help, if directed by the surgeon. Render additional assistance as specifically instructed.

3-15. TETRACAINE HYDROCHLORIDE

a. **General.** Tetracaine hydrochloride, known commercially as "Pontocaine®," is a local anesthetic agent with actions similar to those of procaine hydrochloride. It penetrates mucous membranes deeply and produces rapid and prolonged surface anesthesia. Because of its potency, only weak solutions are required. When used in the eye, it does not dilate the pupil, disturb accommodation, injure conjunctiva, nor raise intra-ocular pressure. Tetracaine hydrochloride is used for surface anesthesia in the eye, nose, and throat; for spinal anesthesia; and for peridural anesthesia. Ointments of tetracaine hydrochloride are used for topical application to various parts of the body.

b. **How Supplied.** This agent is supplied as an ophthalmic solution, as ophthalmic and topical ointments, as parenteral solutions in ampules, and as a tablet for use in the preparation of topical solutions.

c. **Precautions.** When using tetracaine hydrochloride by injection, the personnel must take care to observe proper techniques, to avoid intravascular injection, and to have available facilities for combating overdosage.

d. **Toxic Reactions.** Idiosyncrasy may occur, as well as allergic reaction. The specialist's duties in the event of a toxic reaction are as described in paragraph 3-19.

3-16. TOXICITY OF REGIONAL ANESTHETIC AGENTS

Nesacaine®, a non-topical injectable local anesthetic that is fairly new, is perhaps the safest local anesthetic. All regional anesthetic agents are toxic to some degree, however. For this reason, the smallest amount of anesthetic solution compatible with successful anesthesia should be used. The toxicity of regional anesthetic agents depends not only upon the strength of the solution and the total dose given, but also upon other conditions, including idiosyncrasy and the rate of absorption (rapid absorption of an agent increases its toxicity). As all regional anesthetic agents are potentially toxic, it is imperative that anyone using them be familiar with, and have the facilities for the treatment of, both systemic toxic reactions and true allergic reactions.

3-17. TOXIC REACTIONS TO REGIONAL ANESTHETIC AGENTS

a. **Systemic Reactions.** Systemic reactions occur most frequently. The reactions result from the absorption into the bloodstream of quantities of the drug such that the central nervous system, circulatory system, and the respiratory system may be affected. Symptoms often seen in the patient referable to these systems are as follows:

(1) If the central nervous system (cortex) is excited, the patient may experience symptoms of excitement, apprehension, sudden headache, nausea or vomiting, and muscular twitching which may progress to convulsions and unconsciousness in a late phase.

(2) With circulatory system involvement, the symptoms may be slow pulse, low blood pressure, skin pallor, and possibly total circulatory collapse.

(3) With respiratory system involvement there would be deeper and faster respirations, cyanosis (bluish discoloration), dyspnea (labored breathing), and, later, respiratory failure. The most dreaded outcome is a sudden, simultaneous cardiac and respiratory arrest.

b. **Hypersensitive Reactions.** Hypersensitivity to the anesthetic agents may occur and would produce fainting and respiratory arrest.

3-18. PREVENTION OF REACTIONS

A number of measures may be carried out in an attempt to prevent the reactions discussed previously. Both the person administering the drug and the specialist assisting have important duties in the prevention of reactions.

a. **Duties of Person Administering Drug.** The surgeon or the anesthetist who administers a local anesthetic agent performs a number of duties calculated to prevent a reaction to the drug. Measures that he employs include the ordering of a sedative for preanesthetic administration to the patient, checking the label on the local anesthetic drug, checking the patient for idiosyncrasy or allergy to the drug, and various other measures.

b. **Duties of the Specialist.**

(1) Do not confuse the various agents with another or mistake different concentrations of the same drug.

(2) Make sure that the anesthetic solution is perfectly clear and colorless. If the solution is cloudy, colored, or has particles visible in it, discard it and obtain a fresh supply.

(3) Exercise watchful attention to all details when preparing anesthetic solutions from the bulk drug.

(4) Discard any local anesthetic drug not clearly marked.

3-19. TREATMENT OF REACTIONS--SPECIALIST DUTIES

Whenever the OR specialist assists with a case for which local anesthesia is scheduled, his duties include knowing where the cardiac arrest tray and the defibrillator are located, as well as seeing that the following items are in the room.

a. **Anesthetist's Machine**. An anesthetist's machine is used to give the patient oxygen, if needed. (The surgeon or the anesthetist tests this machine for proper functioning.)

b. **Barbiturate for Intravenous Injection**. The barbiturate (usually thiopental sodium) may be needed if the patient has convulsions.

c. **Vasopressor Drugs**. Vasopressor drugs (ephedrine or phenylephrine) are used for intravenous or intramuscular injection as indicated for the treatment of hypotension or weak pulse.

d. **Suction Machine**. A suction machine is used if the patient vomits or develops excessive secretions in his respiratory tract.

e. **Fluids**. Fluids that are required for intravenous infusion must be present.

f. **Other.** Any additional items that are prescribed by the surgeon or local policy must be present.

Section III. GENERAL ANESTHESIA

3-20. METHODS OF ADMINISTRATION

The following discussion concerns the methods of administering general anesthetic agents.

a. **Inhalation.** With this method, the patient breathes the anesthetic agent, either the vapors of a volatile liquid or a gas. The agent then passes across the alveolar membrane into the patient's bloodstream, and thence to the central nervous system, producing unconsciousness. General anesthetic agents act by breaking the association pathways in the cerebral cortex, thereby causing more or less complete lack of sensory perception and motor activity. Inhalation anesthesia is administered by means of open masks, insufflators, or inhalers. Inhalers are usually parts of machine. Techniques that may be used are as follows:

(1) Insufflation. Following induction, anesthesia may be maintained by blowing the vapor of the anesthetic agent into the patient's upper respiratory passages. This is done by means of either a metal mouth hook placed inside the patient's cheek or a rubber tube introduced through the nose into the pharynx.

(2) Closed technique. The patient rebreathes the anesthetic agent when this technique is used. The typical equipment used consists of a tight-fitting facemask or nosemask, or a tube (such as an endotracheal tube or a pharyngeal airway), a rebreathing bag, a soda lime container (or other provision for the absorption of moisture and carbon dioxide), and provision for the introduction of the anesthetic, as well as the oxygen and carbon dioxide.

(3) Controlled respiration. In order to facilitate manipulations for certain intra-thoracic and intra-abdominal operations, apnea (temporary stopping of breathing) is deliberately induced. The anesthetist then must give the patient artificial (controlled) respiration.

b. **Intravenous.** This is the injection of an anesthetic agent directly into a vein, thus quickly producing a loss of consciousness. Therefore, this method is often used for induction of anesthesia.

3-21. ADMINISTRATION OF INHALATION ANESTHESIA

a. **Procedure Immediately Prior to Induction.** In preparing for the induction of anesthesia, the circulator is to perform or assist in the performance of the following:

(1) Assist the patient in his transfer from the litter to the operating table (visually check the table, to make sure the lift sheet is properly placed on it). A very ill patient, a patient in pain, or one whose circulation is precarious must be moved with extreme care. Any apparatus connected to the patient (intravenous infusions, drainage catheters, and traction gear) must be guarded.

(2) Cover the patient with a sheet or a cotton blanket to keep warm, and for the sake of modesty.

(3) See that the patient's legs are uncrossed to avoid pressure on nerves.

(4) Place small pillows under the arch of the patient's back and beneath his knees (or flex the operating table) to minimize postoperative backache.

(5) See that the patient is wearing an OR cap to cover his hair and thus promote sterile conditions.

(6) Ask the anesthetist whether he needs assistance. He will usually arrange armboards, set up intravenous solutions, and place blood pressure cuffs as necessary for the case. However, if he is rushed before a case, the anesthetist may require assistance for all of these tasks.

(7) Plug in the suction machine, check it, and push it near the head of the table in such a position that the anesthetist has access to it. Never disconnect this machine or move it away from the table until the patient is out of the room. Keep the top of the machine clear of everything except the vessel of water in which the suction catheter is rinsed.

(8) Place the leg strap in position and fasten it.

(9) Secure the patient's arms in the lift sheet (before induction begins) in such a way that they are protected against injury.

b. **Procedure by Circulator During Induction.**

(1) Help maintain quiet in the room, particularly during the induction period. The patient's sense of hearing is more acute during induction, thus any sound in the room is greatly magnified. Moreover, the sense of hearing is the last to leave the patient as he becomes unconscious.

(2) DO NOT touch the patient during induction. If the sheet has not been properly arranged, wait until after the induction to rearrange.

(3) Stand by to give assistance. Induction is the most crucial period of the patient's anesthetic, and the anesthetist may need assistance. On occasion, the anesthetist may request the help of a person not in the room, in which case you are to leave the room to obtain the person needed. At no other time during the patient's induction should you leave the patient's side.

c. **Procedure by Circulator Following Induction.** Be prepared to assist the anesthetist during intubation and extubation of the patient. The anesthetist will give specific orders as to what you are to do.

d. **Procedure by Anesthetist.** The anesthetist administers the anesthetic agent by one of the techniques previously discussed.

e. **Recording.** During general anesthesia (when the anesthetist administers the anesthetic agent), the anesthetist records all information on the patient's record. However, if the specialist is ordered to give treatment or medication, he writes the full information on a slip of paper and gives it to the anesthetist. This information includes the name, strength, amount of the drug given, and the time and method of administration.

3-22. ADMINISTRATION OF INTRAVENOUS ANESTHESIA

a. **Procedure by Circulator.** The circulator is to proceed as described above for inhalation anesthesia.

b. **Procedure by Anesthetist.** The anesthetist prepares and administers the anesthetic agent.

3-23. STAGES OF GENERAL ANESTHESIA

As the concentration of a general anesthetic drug increases in the brain, the patient may go through four stages (see figure 3-4) of reaction as follows.

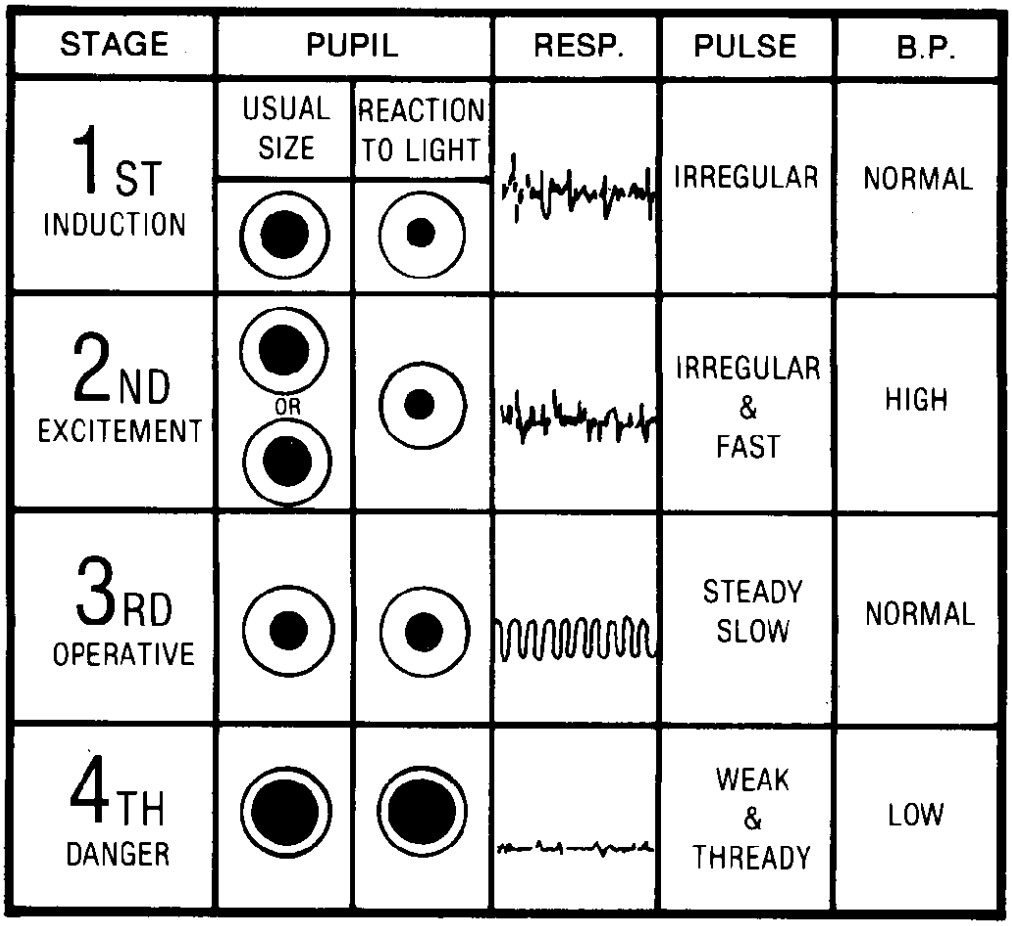


Figure 3-4. Stages of anesthesia.

a. **Stage I--Analgesia.** This stage lasts from the beginning of the administration of anesthesia to the beginning of the loss of consciousness. It is accompanied by dizziness and by exaggerated hearing and feeling. This stage is adequate for cystoscopy and for simple incision and drainage.

b. **Stage II--Excitement.** This stage lasts from the loss of consciousness to the loss of the eyelid reflex (which marks the beginning of surgical anesthesia). This stage is often brief in patients well premedicated. However, any kind of stimulation (such as noise, or touching the patient) intensifies the patient's excitement. He may vomit, hold his breath, or struggle; he has increased muscle tone and involuntary motor activity.

NOTE: Stages I and II comprise the induction period.

c. **Stage III--Surgical Anesthesia.** Most operations are performed at this stage of anesthesia, which begins following the excitement stage. Spinal reflexes are dulled and therefore relaxation of skeletal muscles is obtained. The third stage of anesthesia is further subdivided in to four planes of anesthesia, each of which is defined by the progressive loss of certain reflexes and muscle tone. Plane one signifies the lightest level of stage III anesthesia and plane four the deepest level.

d. **Stage IV--Medullary Paralysis.** This stage begins when the anesthetic depresses the medulla. Respiration becomes shallow and irregular resulting in anoxia (lack of oxygen) in the tissues. The skin first becomes pale and then cyanotic. This is the stage of cardiac and respiratory paralysis and death. The anesthetist guards against allowing the patient to reach this depth of anesthesia.

3-24. BASAL ANESTHESIA

This is anesthesia short of surgical anesthesia produced by giving enough preanesthetic medication or a specific basal anesthetic agent. An advantage of basal is that it produces unconsciousness, thus allowing the patient to be brought to the OR without his awareness, yet he is not depressed as though for a surgical procedure.

3-25. ETHER

a. **Description.** Ether is a standard general anesthetic agent. It is a transparent and colorless volatile, highly flammable fluid, with a characteristic odor. Ether is rarely used.

b. **Action.** Anesthesia with ether provides a degree of relaxation well suited to surgical manipulations. Ether is not highly toxic.

3-26. NITROUS OXIDE

a. **Description.** Nitrous oxide, some-times called "laughing gas" and nitrogen monoxide, is a standard general anesthetic agent in common use. Nitrous oxide is a colorless gas. It is administered from compression tanks through tubes that connect with a tight-fitting mask (closed technique).

b. **Concentration Used.** Nitrous oxide is usually given in a mixture of 8 percent oxygen and 92 percent nitrous oxide.

c. **Action.** Nitrous oxide provides only very light anesthesia unless its action is enhanced by other agents, such as ether. It is useful for anesthesia or analgesia for superficial procedures, or as an induction agent. Nitrous oxide will not explode, but will support combustion.

d. **How Supplied.** This gas is supplied in cylinders of various capacities.

3-27. THIOPENTAL SODIUM

a. **Description.** Thiopental, also known as sodium pentothal, is a standard anesthetic agent used for general anesthesia. This nonvolatile agent is a barbiturate and is clear in solution. Thiopental is classified as ultra-short acting on the basis of duration of its hypnotic action.

b. **Administration.** Thiopental may be given either intravenously for the induction of anesthesia or rectally for basal anesthesia.

c. **Action.** Thiopental, one of the more potent barbiturates, is a hypnotic drug. It has little if any analgesic action; in fact, its administration in the presence of pain may cause restlessness, disorientation, and excitement. Therefore, the use of this agent is contraindicated in instances of impending shock or morphine overdosage.

d. **Chief Uses.** Thiopental is used mainly for induction of anesthesia. It is useful for such brief procedures as closed reduction of a fracture or discoloration and for minor operations, provided the airway can be protected at all times. For most surgical procedures, thiopental must be supplemented with another anesthetic agent.

3-28. TOXIC REACTIONS TO GENERAL ANESTHETIC AGENTS

These may occur, as with local anesthetic agents, even though the anesthetist employs measures to prevent them. If an untoward reaction begins, the anesthetist takes steps to overcome it. The specialist assists as directed by the anesthetist.

Section IV. EMERGENCIES IN ANESTHESIA

3-29. SPECIALIST'S ROLE IN EMERGENCIES

a. **General.** As an assistant to the anesthetist, the specialist has an important role in anesthetic emergencies. Therefore, it is necessary that he understand the hospital's preparedness program and the management of emergencies. He must know the nature and the location of all emergency equipment located in the suite, and he is expected to react quickly and calmly during any emergency. Some emergencies may occur daily (for example, vomiting), and others very infrequently (cardiac arrest, fires, and explosions). Any emergency requires immediate action.

b. **Preparedness--Circulator's Duties.**

(1) Equipment. During an emergency in anesthesia, the life of the patient may be dependent upon the ability of each member of the surgical team to know thoroughly what is required of him and to do it immediately. Since the circulator has the duty of obtaining additional equipment needed, he should learn where all equipment is

kept (whether in the surgical suite's sterile supply room or the anesthesia workroom), as well as, what special equipment for emergencies (such as a defibrillating machine) looks like. If the anesthetist needs further assistance by the circulator, he will give specific instructions.

(2) Preparation of the room. In order that the circulator and the anesthetist will be prepared for possible emergencies, the circulator should have the following items ready in the room:

(a) Sufficient armboards and intravenous standards to start an extra infusion.

(b) Extra infusion sets and solutions.

(c) Individually wrapped syringes and needles for emergency drugs.

(d) A workable suction machine for all cases, including those done under local anesthesia.

(e) An oxygen supply (anesthesia machine) ready for all cases, including locals.

c. **Discussion.** The ensuing discussion (see paras 3-30 through 3-34) is not inclusive of all possible anesthetic emergencies, but it does deal with those most directly related to anesthesia and its effects on the patient. If the specialist will master the principles set out concerning preparedness and management, he will be able to apply this knowledge to the emergencies described and thus function effectively in preserving human life.

3-30. FIRES AND EXPLOSIONS

a. **Incidence.** These are drastic in scope, but infrequent in occurrence. The death rate from this source has been estimated at approximately one in 1 1/2 million patients undergoing anesthesia.

b. **Predisposing Factors.** The elements necessary for a fire or explosion are: a combustible substance, a source of ignition, and oxygen or an oxygen-supplying substance. A large number of the safety measures practiced as well as many features in the construction of an OR are employed to prevent the simultaneous occurrence of the three elements cited.

c. **Management.** If a fire or explosion occurs, lives of both the patient and personnel may be lost. This is the reason for directing unrelenting effort toward the prevention of such disastrous hazards. If a fire should start, every effort is made to keep it contained until it can be put out--otherwise a series of explosions may occur.

3-31. CARDIAC ARREST

Cardiac arrest is the sudden and unexpected stoppage of the heart. In the surgical patient it may occur prior to or during induction, during the course of surgery, or postoperatively.

a. **Incidence.** The patient's heart may stop during any type of a surgical procedure, major or minor, and the incidence is about 1 in 800 general anesthesia procedures.

b. **Importance of Time.** This factor can be fully appreciated by recalling that when the heart stops there is no circulation, and without circulation, there is no oxygen to the tissues. Because the tissues of the brain are particularly vulnerable to anoxia, the maximum time element for institution of successful treatment is considered to be from 3 to 5 minutes. The patient may be revived following a longer time interval, but probably will have incurred brain damage.

c. **Preparedness.** Because cardiac arrest is so dire an emergency, hospital policy requires that a program of preparedness be in effect. Necessary equipment is therefore located in the surgical suite, in other areas where anesthesia is administered to patients, and in areas where patients are recovering from anesthesia--either local or general. All personnel working in the areas should know where the cardiac arrest tray is located. It is checked periodically according to local SOP.

(1) Contents of cardiac arrest tray.

(a) A knife with a blade attached is the first item on opening the tray, or the knife may be kept ready for use in a large test tube on top of the cardiac arrest tray.

(b) The tray should also contain a large self-retaining rib spreader or retractor, needed after the knife, which will free the surgeon's assistant to start an additional infusion.

(c) Syringes and needles may be among the first items in the tray, ready for giving emergency medication. They may also be wrapped separately and stored with the tray.

(d) The hemostats, needle holder, sponges, and other items in the tray are needed only after a normal heartbeat has been established and are placed in the tray accordingly.

(2) Other equipment needed.

(a) Oxygen is needed at once. The anesthesia machine furnishes the source of oxygen.

(b) A defibrillator-pacemaker machine may be needed. Usually, there is one of these machines per hospital, and it is kept in the surgical suite. It is not the first item needed, therefore the circulator has sufficient time to obtain it and bring it into the room.

d. **Predisposing Factors.** Although the exact causes of cardiac arrest are hard to determine, there are several common factors, which singly or in combination may precipitate cardiac arrest, as follows:

(1) Drug overdosage preoperatively.

(2) Anoxia of the heart muscle from any cause.

(3) Trauma to the heart or the pericardium during surgery.

(4) Over stimulation of the vagus (cranial) nerve.

(5) Manipulation of the patient during induction.

(6) Toxic reaction to the anesthetic agent.

e. **Diagnosis.** This is usually made by the anesthetist, who has as presumptive evidence the absence of pulse and blood pressure.

f. **Management.** Cardiac arrest may be treated by either closed (external) or open cardiac massage. If the surgeon elects to use closed cardiac massage, he carries out the procedure as it is used elsewhere in the treatment of cardiac arrest. In the management of cardiac arrest in the OR, however, the surgeon may desire to perform open cardiac massage in some instances. Therefore, a discussion concerning treatment by open cardiac massage is presented in the ensuing paragraphs (through g below).

(1) Treatment by the surgeon. Immediate treatment by the surgeon consists of gaining access to the heart by opening the chest wall at an appropriate interspace between the ribs (such as the 5th), grasping the heart in his hands and massaging it with a pumping motion, while an assistant retracts the patient's ribs. Aseptic technique (prepping and draping) is sacrificed in this instance.

(2) Treatment by others. The head of the table is lowered to provide gravity flow of blood to the brain tissue, where it is most vitally needed. In the meantime, the anesthetist provides an open airway, intubating the patient if necessary, and gives 100 percent oxygen. In addition, the circulating volume of fluid must be increased because

pumping by the surgeon's hands is not as adequate as is the pumping of the heart itself. Therefore, the intravenous infusion running (if one is running) is speeded, and a vasopressor drug (such as ephedrine) is added. The specialist will do this, if ordered. An additional infusion may be started immediately using a large gauge needle (no smaller than 18-gauge) and a transfusion set because the patient may need a transfusion later.

(3) Medication. The surgeon may request that certain drugs be prepared for direct injection into the heart muscle, either to stimulate it to contract (epinephrine) or to increase the muscle tone (calcium gluconate). The heart may resume its normal beat without too much difficulty or it may go into fibrillation--a series of rapid, feeble beats with no particular harm. Such beats are not adequate to establish blood flow, and if they occur, the defibrillator-pacemaker machine is used. In this procedure, the sterile electrodes are placed directly on the heart to shock it into a standstill; then the cycle of massage is restarted.

g. **Procedure by Specialists.** As soon as a diagnosis of cardiac arrest is made, the OR specialists must act as assistants to both the surgeon and the anesthetist. Usually the scrub assists the surgeon and the circulator aids the anesthetist. The specialists are to take action as follows:

(1) The scrub presents a knife (scalpel) to the surgeon as soon as the diagnosis is made. This will usually be a knife from the operative field, but may be from the test tube on the cardiac arrest tray. **Use the first knife available without wasting time!**

(2) The circulator assists with lowering the head of the table and help the anesthetist as ordered.

(3) The circulator secures as necessary an endotracheal set, extra armboard, and infusion supplies (set and fluids).

(4) The scrub obtains the self-retaining rib spreading for the surgeon.

(5) The scrub will have syringes and needles available for emergency drug as ordered.

(6) The circulator will bring the defibrillator machine to the room, set it up, if necessary. Instructions for preparing this machine for use are on a typed card with the machine. There is no hurry for this step.

(7) The scrub sets up a sterile field for closure of the chest after the emergency has been controlled. The scrub is to set up a sterile, water-seal drainage

apparatus. After the heart starts a normal beat, it is watched for at least 20 minutes before closure of the chest wall is begun. Aseptic technique is reinstituted at this time, and the area is properly prepared and draped. There is no bleeding from wound edges until an adequate heartbeat is established.

3-32. LARYNGOSPASM

a. **General.** Laryngospasm is contracture of the larynx, preventing the entrance of air into the lungs. This condition frequently occurs during induction of anesthesia and is the most common complication of induction with thiopental. Laryngospasm usually can be easily controlled. Treatment is directed at the factor, which precipitated laryngospasm.

b. **Precipitating Factors.** Laryngospasm may result from any of the following, or from a combination of them:

(1) The presence of excessive secretions in the patient.

(2) Certain allergic conditions, such as asthma.

(3) Irritation of the larynx by the anesthetic agent, by the acid content of vomitus, or by the insertion of an airway before the patient is completely anesthetized.

(4) Disturbance of the patient by sound or touch during induction.

c. **Symptoms.** The following symptoms indicate respiratory obstruction: coughing, wheezing respiration, gasping, uneven respiration, and cyanosis.

d. **Procedure by Circulator.** When laryngospasm develops, the circulator is to proceed as follows:

(1) Secure an endotracheal tray for the anesthetist if no tray is in the room.

(2) Stand by to assist the anesthetist with intubation as ordered in any of the following ways:

(a) Compress the breathing bag (providing positive pressure) while the anesthetist prepares a muscle relaxant or intubates the patient.

(b) Get a different size intubation tube if necessary.

(c) Procure and open an emergency tracheostomy tray if intubation cannot be accomplished successfully.

3-33. VOMITING

Emesis (vomiting) interferes with surgery and can be very dangerous since it predisposes to both aspiration (the sucking of fluid into the lungs) and laryngospasm.

a. **Incidence.** Vomiting occurs frequently in surgery. Patients most often vomit while waiting for anesthesia to start, during induction, or upon extubation.

b. **Predisposing Factors.** Factors that predispose to vomiting are as follows:

(1) A full stomach prior to surgery. For this reason, food and fluids are routinely withheld before surgery.

(2) Adverse reaction to the preoperative medication.

(3) Stimulation of the pharyngeal reflex by an artificial airway or by secretions.

(4) Fear or pain or both.

c. **Procedure by Specialist.**

(1) Local anesthesia. If the surgery is being done under local anesthesia and no anesthetist is in the room, the circulator is to do the following:

(a) Have the patient turn his head to one side; support it if necessary.

(b) Secure an emesis basin (from the anesthesia table) and hold it for the patient.

(c) Use a cold, damp towel to the patient's mouth.

(d) If the patient aspirates vomitus, lower the head of the table, use suction, and encourage him to cough.

(e) Notify an anesthetist as soon as the patient can be left safely. The anesthetist may administer oxygen or he may give further medication for pain and relaxation.

(2) General anesthesia. If the patient is unconscious, the circulator is to do the following:

(a) Push the suction machine to the head of the table for the anesthetist and turn it on.

(b) Help lower the head of the table to prevent aspiration.

(c) Secure an emesis basin if the quantity of vomitus is too excessive to be withdrawn with the suction tip.

(d) Obtain a towel for wiping the patient's face.

(e) Help hold the patient's face to one side to avoid contamination of the field and to help prevent aspiration.

3-34. OTHER EMERGENCIES

a. **General.** Various emergencies other than those discussed above may occur, the chief of these being shock and hemorrhage. The principles employed in handling these emergencies are the same in the OR as they are elsewhere when shock and hemorrhage occur: treatment is directed toward preventing a worsening of the complication and toward relieving it. Main points of therapy (by the anesthetist and surgeon) are discussed below.

b. **Shock.**

(1) Give oxygen, as it is vital to brain tissue.

(2) Give intravenous infusion to stimulate the circulating volume, often with a vasopressor drug such as ephedrine.

(3) Position the patient with his head low to facilitate circulation to the brain.

(4) Give various medications as needed. The following may be given:

(a) Epinephrine and Benadryl.

(b) Hydrocortisone.

(c) Aminophylline.

(d) Vasopressors.

(e) Sodium or potassium iodide.

c. **Hemorrhage.**

(1) Find source of bleeding and stop it.

(2) Replace lost blood with whole blood as soon as possible.

(3) Give oxygen as needed.

d. **Specialist's Duties.** Obtain items needed to manage the emergency and assist as directed by the anesthetist and the surgeon.

Section V. PARENTERAL THERAPY

3-35. INTRODUCTION

a. **General.** Parenteral medications are those that are given by some route other than through the alimentary (gastrointestinal tract) canal. A discussion of injection technique (for parenteral medications) is presented in order that the OR specialist may learn the principles associated with the administration of medication by this route and that he may learn acceptable procedures for giving injections while applying the appropriate principles. The principles discussed should be mastered, and the procedures should be practiced until the specialist attains accuracy, skill, and speed in accomplishing them. This level of ability is advised because when the OR specialist is asked to give an injection, an emergency often exists so that life is dependent upon quick, accurate action.

b. **Indications.** A parenteral route is indicated for any drug given in the OR (even though the patient is conscious) since anything taken orally may induce vomiting; in addition, a rapid effect is usually desired.

c. **Techniques.**

(1) The injection technique is used to introduce a small amount of fluid subcutaneously, intramuscularly, or intravenously.

(2) The infusion technique is used to introduce large amounts of fluid into veins.

3-36. PRELIMINARY PREPARATION FOR INJECTION

a. **Syringe and Needle.**

(1) The size syringe used depends upon the amount of medication to be given or upon the needs of the procedure to be done. As an example, a 10 ml control syringe may be used to inject 1 or 2 ml of anesthetic solution.

(2) The choice of needle (length and gauge) depends upon the type of injection to be given.

b. **The Specialist.** After receiving the order to administer an injection, the specialist is to assemble the necessary equipment.

3-37. PREPARATION FOR INJECTION

a. **Procedure for Preparation of Liquid Medication.**

(1) Select the sealed vial of liquid medication and read the label; then select needle and syringe from the sterile supply available.

(2) Assemble the syringe and needle, being careful not to touch or otherwise contaminate the needle shaft or the inner parts of the barrel and plunger.

(3) Inspect the needle visually for burrs. Inspect it also for patency (openness) by pulling back on the plunger. Replace the needle cap (cover) without contaminating the needle.

(4) Read the label on the medication vial again.

(5) Wipe the rubber stopper of the vial with an alcohol sponge.

(6) Draw back the plunger of the syringe to the mark on the barrel, which corresponds to the amount of liquid to be withdrawn.

(7) Holding the vial upside down, insert the needle through the stopper and inject the air in the syringe into the vial (see figure 3-5) to replace liquid about to be withdrawn. Adjust depth of needle, if necessary, to assure that needle tip is in liquid, not in air in the vial.

(8) Withdraw the prescribed quantity of liquid medication by pulling the plunger back to the mark on the barrel. Hold the barrel firmly (see figure 3-5) to avoid separating the barrel from the needle. If air is aspirated, return the plunger to zero, readjust the depth of the needle, and withdraw the liquid.

(9) Grasp the hub of the needle with fingers of one hand and holding vial in the other hand, withdraw the needle from the stopper.

(10) Read the medication label a third time.

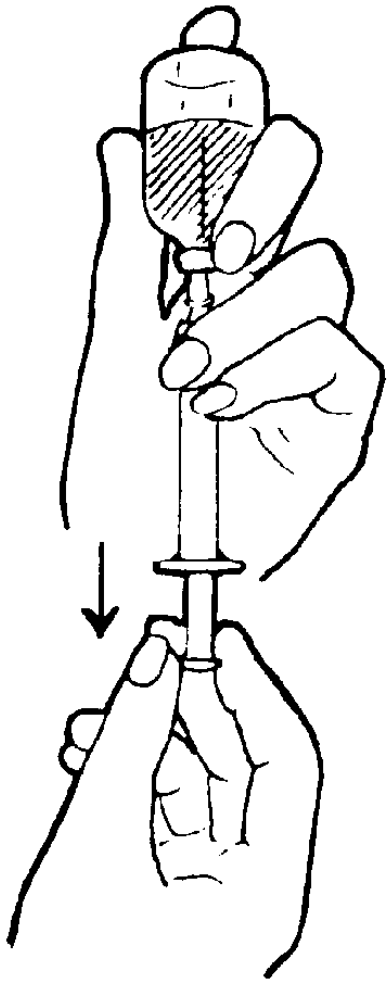


Figure 3-5. Withdrawing medication with vial inverted.

(11) Hold the syringe with the needle upward between eye and light source. If necessary, tap the syringe lightly to cause air bubbles (due usually to faulty withdrawal technique) to dislodge from the side and rise to the top. Expel minute amount of liquid to assure that the syringe and needle contain no air. When all air is expelled, the medication is ready for injection. Prepare the patient for injection as discussed in para 3-37c below.

b. **Procedure for Preparation of a Tablet.** The procedure for preparing a 0.5 mg tablet of scopolamine in 1 ml of normal saline is given below. The procedure for preparing other tablets in solvents is similar.

(1) Select a supply of scopolamine tablets and a sealed vial of sterile normal saline. Select a sterile syringe and needle and a sterile medicine glass.

(2) Unwrap the sterile medicine glass and set it upright without contaminating the rim or the inside.

(3) Check the labels on both the medication and the solvent bottle as discussed in paragraph 3-37a above.

(4) Remove the cork from the scopolamine container, transfer a tablet to the medicine glass, then replace the cork in the container.

(5) Unwrap and assemble the syringe and needle. Guard against contaminating the equipment, and inspect the needle.

(6) Wipe the top of the solvent bottle with an alcohol sponge, and using the technique described (see para 3-37a), withdraw the prescribed amount of fluid.

(7) Expel the fluid from the syringe onto the tablet in the medicine glass, thus helping dissolve the tablet. Continue to agitate the solution by drawing it into the syringe and expelling it out until the tablet is completely dissolved.

(8) Draw the solution into the syringe, and cover the needle with a plastic shield needle cover or with sterile sponges if a plastic cover is not available.

(9) Prepare the patient for the injection as discussed in paragraph 3-37c below.

c. **Preparation of Patient for Injection.**

(1) If the patient is conscious, prepare him for the injection by explaining simply what is going to be done and then exposing the site for injection.

(2) Using an alcohol sponge, cleanse the skin with a spiral motion, beginning at the planned injection site and continuing outward to include an area three inches in diameter. If the prepared site is touched by fingers or clothing before the needle is inserted, repeat the cleansing.

3-38. CARE OF THE EQUIPMENT

Following the administration of an injection, the equipment is to be cleaned or discarded, depending upon whether it is reusable or disposable.

a. If the needle, the syringe, or both are disposable, break and discard them.

b. If the equipment is the reusable type, clean it by separating the barrel from the plunger and rinsing both parts of the syringe and the needle with cold water. Attach the separated barrel and plunger with a rubber band and place both the syringe and needle in the container designated for these items. This equipment is returned to the centralized materiel section for further processing.

c. Discard the used sponges and empty vials in the trash.

3-39. SUBCUTANEOUS (HYPODERMIC) INJECTION

a. **General.** The subcutaneous (hypodermic) injection (see figure 3-6) is most commonly used for administering narcotics, sedatives, and immunizing materials. It may also be used for administering local anesthetic solution. The full effect of drugs given by this route usually is manifested within 20 to 30 minutes if the circulatory picture is near normal. The usual amount of medication is 2.0 ml or less. The outer aspect of the upper arm is the most common injection site for a subcutaneous injection.

b. **Procedure for Giving Injection.**

(1) Prepare a 2 ml syringe and a small-gauge needle (25 to 26 gauge needle no longer than 5/8 ml). Prepare the medication of administration.

(2) Expose and cleanse the site with an alcohol sponge.

(3) Expel the air from the syringe (see figure 3-6).

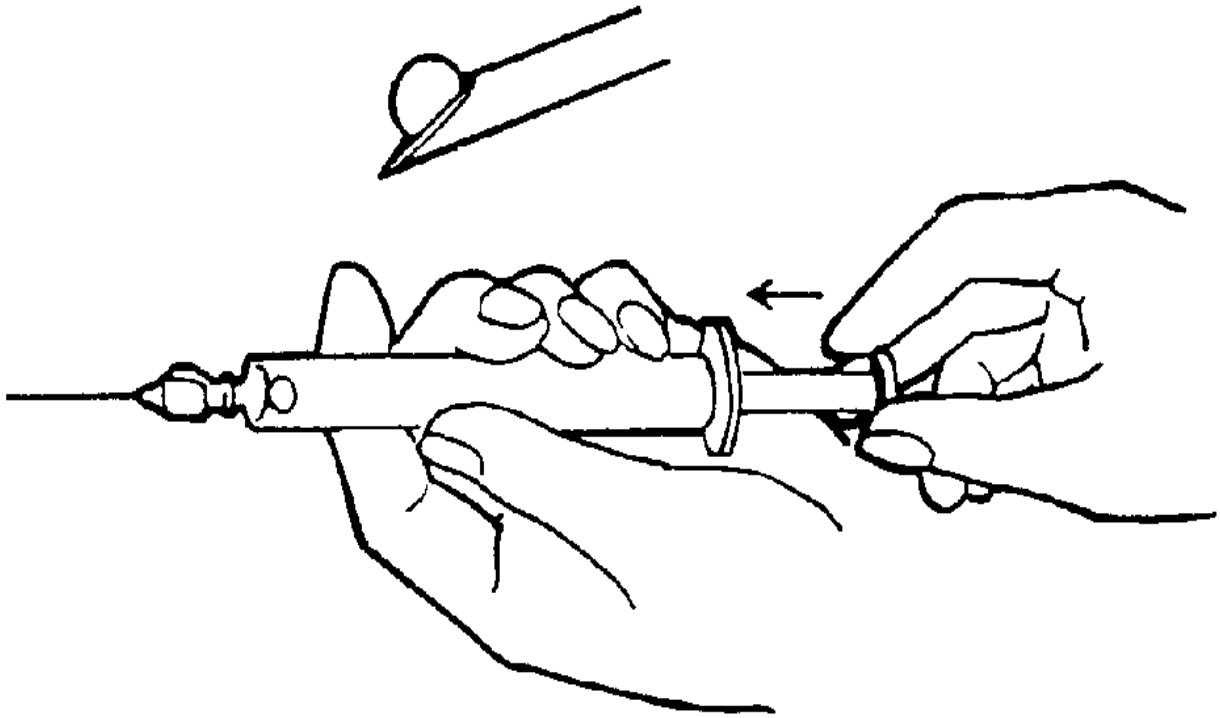


Figure 3-6. Clearing air bubbles from syringe.

(4) Grasp the flesh to make a cushion, and holding the syringe at a 45-degree angle to the skin, insert the needle quickly (about 1/2 inch) into the subcutaneous tissue (see figure 3-7).

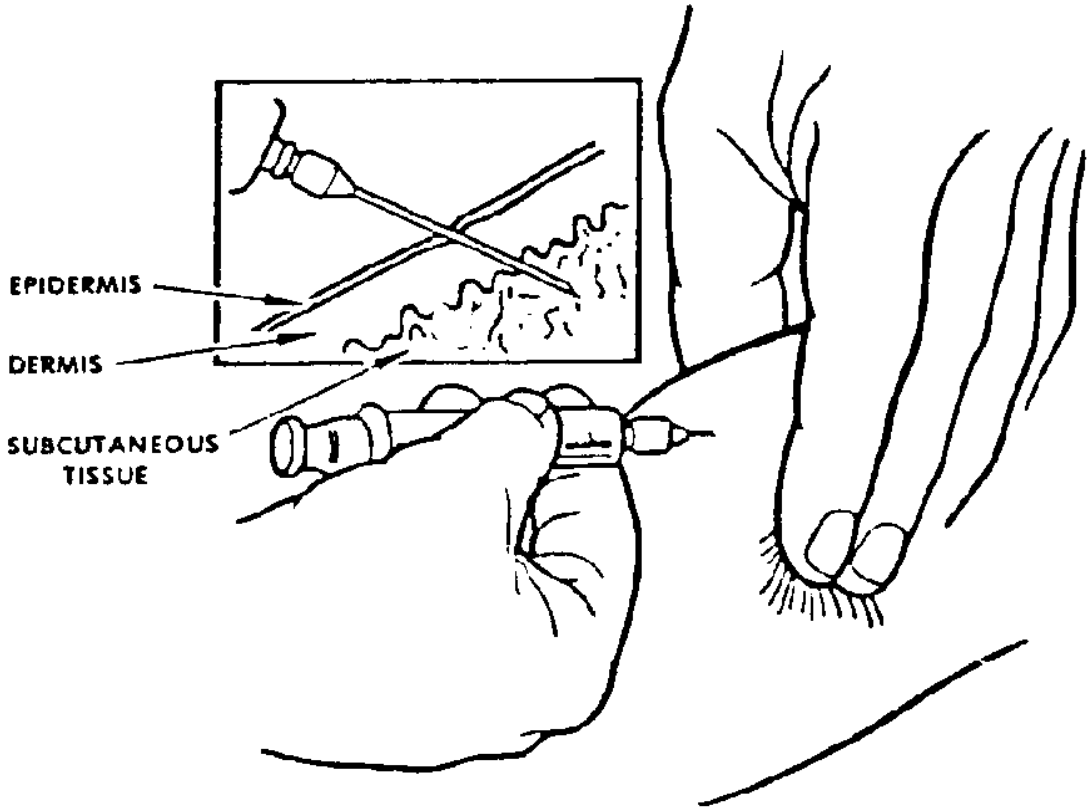


Figure 3-7. Administering a subcutaneous injection.

(5) After inserting the needle, pull back slightly on the plunger. If no blood is aspirated, give the injection. If blood is aspirated, withdraw the needle, replace it with a sterile one, expel the air from the syringe, and inject into a different place. If no blood is aspirated, exert gentle, consistent pressure on the plunger, thus expelling the medication into the subcutaneous tissue (see figure 3-7).

(6) Use an alcohol sponge to apply pressure briefly over the site of injection.

(7) Record the administration of the injection, the name of the medication given, the dosage administered, the method of administration, and the site of the injection.

(8) Clean the equipment.

3-40. INTRAMUSCULAR INJECTION

a. **General.** The intramuscular (IM) injection is used for the same purposes as the subcutaneous injection. This technique is selected in preference to the subcutaneous when the medication is irritating, when more rapid absorption is desired, and when there is a larger quantity of medication than can be readily absorbed by the subcutaneous tissues. In addition, medications for intramuscular injection sometimes

are oily rather than watery, and oily solutions are not absorbed well by subcutaneous tissue. Since there is added risk of the needle striking a nerve, bone, or large blood vessel, the site of intramuscular injection must be chosen with care. The area in which these structures are least likely to be hit is above and to the outer side of the intersection of two lines dividing the buttock into four equal parts (see figure 3-8 A), where the gluteal muscles are thick and where there is the least likelihood of striking bones, large nerves, and blood vessels. The appropriate anatomic site is the upper, outer quadrant area of the buttock.

b. **Injecting the Buttock.**

(1) Prepare a 2, 5, or 10 ml syringe with a 1 1/2-inch, 21-gauge needle, and prepare the medication as described above (see para 3-37a and b).

(2) Imagine crossed lines dividing the buttock into four equal parts and select the site of injection as illustrated in figure 3-8 A.

(3) Cleanse the area with alcohol.

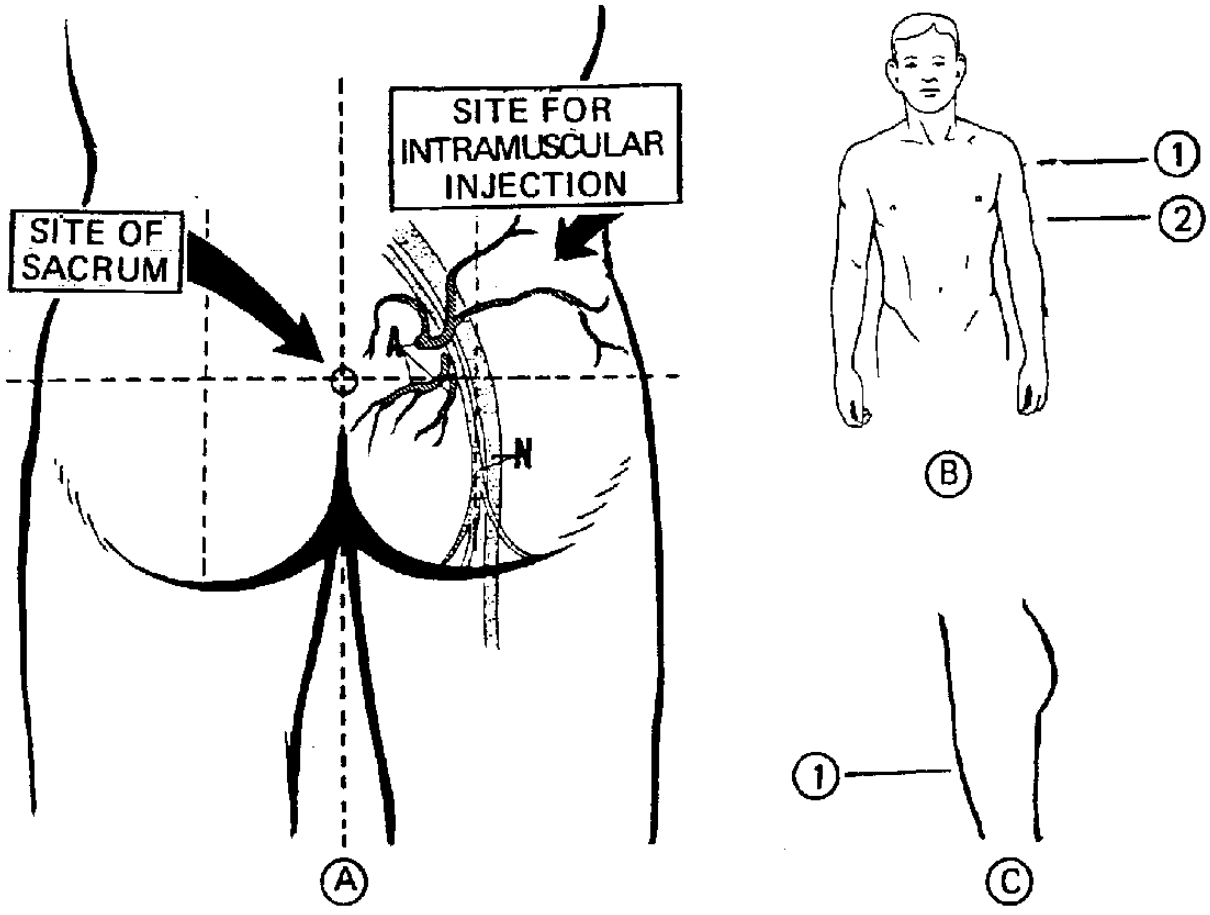


Figure 3-8. Sites of intramuscular injections.

(4) Holding the skin taut with the thumb and forefinger, inject the needle with a stabbing motion to about half the desired depth and at a right angle (90º) to the skin. Make a second push on the barrel of the syringe, using just enough pressure to place the needle hub about 1/4-inch from the skin. Pull back the plunger in the syringe slightly to determine whether the needle is in a blood vessel. If any blood appears in the syringe, withdraw the needle, replace it with a sterile one, expel the air from the syringe, and insert it into a different place. If no blood appears in the syringe, press the plunger slowly, expelling the medication into the muscle.

(5) Withdraw the needle with a quick pull; then press the injection site with an alcohol sponge.

c. **Injecting the Thigh and Upper Arm.** (See figures 3-8 B, C), either of these sites may be used if the buttocks are inaccessible, for example, if the patient is in a supine position and covered with sterile drapes. A needle 1 inch long has sufficient length for injecting the upper arm or thigh. A 2-ml syringe is used, but doses as large as 2 ml usually are injected into the buttock rather than the arm or thigh. The procedure for injecting the arm or thigh is the same as for injecting the buttock except for site selection. The most muscular part of the upper arm is selected (see figure 3-8 B). A site on the front of the thigh well away from the groin and the knee is satisfactory (see figure 3-8 C).

d. **Other Site.** If the patient's position, condition, or the operative area prevents easy access to and exposure of the buttocks, upper arms, thighs, or the calf of the leg may be used.

3-41. INTRAVENOUS ADMINISTRATION

a. **General.** The injection or the infusion of fluids into the veins requires a higher degree of skill than does the injection of fluids by the other methods described (see paras 3-39, 3-40). Intravenous injections and infusions given during surgery are normally performed by the anesthetist, with the specialist assisting. Intelligent assistance requires knowledge of every step of a procedure. In addition, the specialist should bear in mind that he may be required to perform a venipuncture under certain circumstances. Accordingly, the following text (see paras 3-42 through 3-50) presents appropriate procedure for intravenous injection, the withdrawal of a blood sample, intravenous infusion technique, and blood transfusion technique.

b. **Venipuncture.** Venipuncture is the entering of a vein with a needle to inject medications or intravenous solutions or to obtain a blood specimen for laboratory tests.

3-42. INTRAVENOUS INJECTION

a. **General.** Intravenous injection is the administration of a small amount of medication directly into the venous bloodstream. This method of administration is usually employed when very rapid action of the drug is desired.

b. **Medication Suitable.** Medication administered in this way is especially prepared for intravenous use. The procedure is done using sterile equipment and aseptic technique. Preparation for the injection is as set forth in paragraph 3-37, and in addition, the specialist (if asked to obtain the drug) must check to see that the label indicates that the drug may be given intravenously. All drugs that may be given by this route are so marked.

c. **Procedure.**

(1) Prepare a syringe appropriate for the amount of fluid with a 1 1/2-inch needle of 20- to 23-gauge and withdraw the medication from the vial into the syringe.

(2) Place a tourniquet around the patient's upper arm and draw it tight enough to block the veins but not the arteries (see figure 3-9 A). (The radial pulse should be felt below the tourniquet.)

(3) Select the prominent vein in the skin over the antecubital space (front of the elbow, see figure 3-9 B). If necessary, pat or rub the skin lightly and, if possible, have the patient close and open his hand to make the veins more visible.

(4) Cleanse the skin with alcohol (see figure 3-9 C).

(5) With the thumb of the left hand on the skin below and to one side of the injection site, anchor the vein by stretching the skin toward the patient's hand. (Figure 3-9 D does not show the thumb in place. This was omitted for clarity of illustration.)

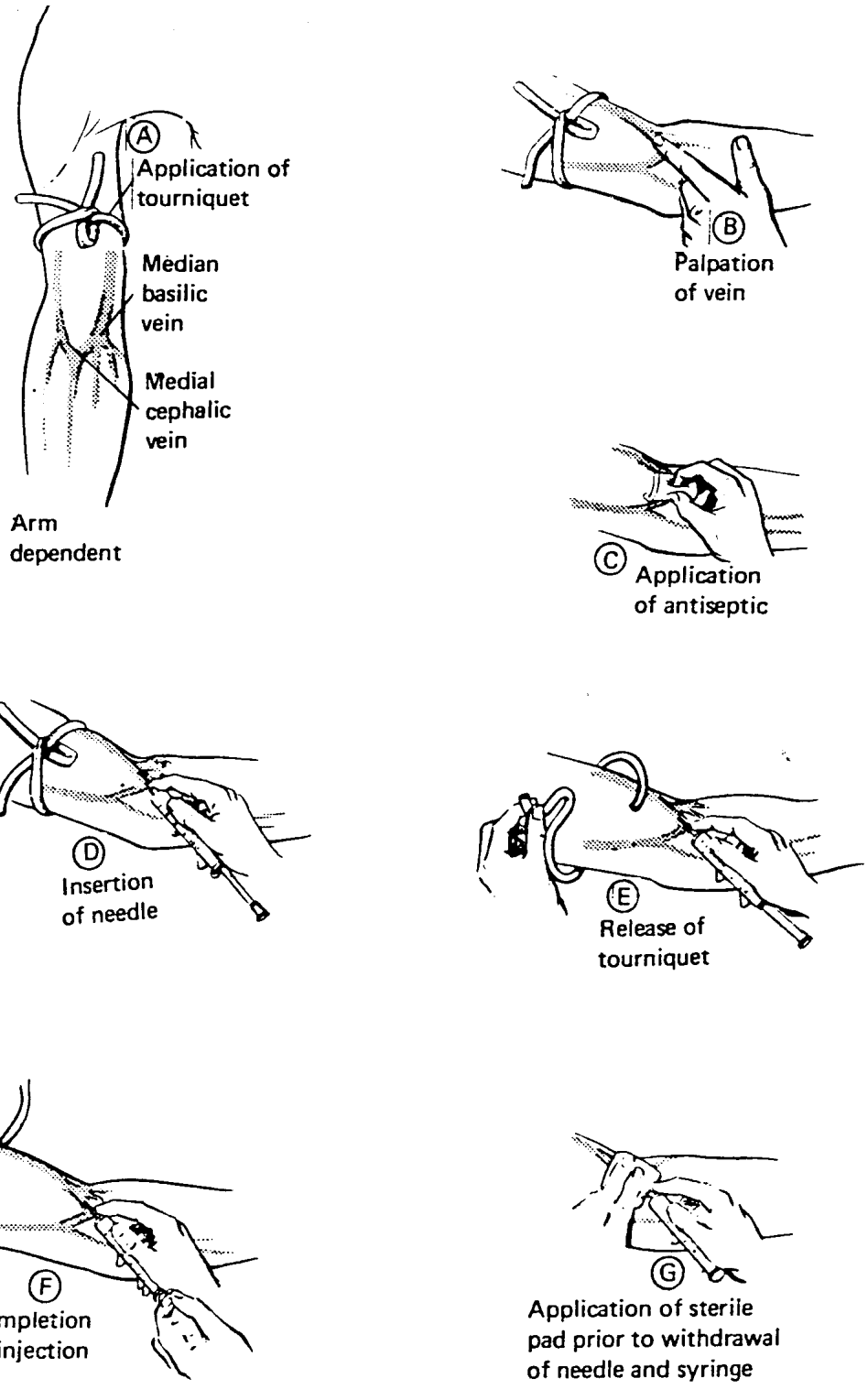


Figure 3-9. Intravenous injection procedure (venipuncture). (Veins enlarged for clarity.)

(6) Hold the needle in the direction of venous blood flow with the needle point bevel up, parallel to and about 1/2 inch below the site of the venipuncture. Adjust the needle at approximately a 30 degree angle, insert it through the skin, lower it to a flat angle, then move it forward parallel to the vein for about 1/2 inch. With a slight sidewise movement, direct the needle point into the vein, extending it into the lumen of the vein about 1/4 inch (see figure 3-9 D).

(7) Pull back on the plunger slightly to be positive that the needle is in the vein. If blood is aspirated into the syringe, release the tourniquet and inject the medication (see figure 3-9 E). If blood is not aspirated, try once again to direct the needle into the vein. On repeated failure, release the tourniquet, withdraw the needle, replace it with a sterile one, expel the air from the syringe, tighten the tourniquet, and repeat the procedure at a different site.

(8) After injecting the medication, cover the injection site with a sterile pad (see figure 3-9 G), withdraw the needle, and press the pad firmly over the puncture site for about 2 or 3 minutes to prevent the extravasation of blood (the escape of blood into the tissues).

(9) Clean the equipment according to the local policy; destroy the disposable equipment.

(10) Record on a piece of paper the treatment done, sign it, and give it to the anesthetist. The recording includes writing the drug, dosage, the time given, and the method.

3-43. WITHDRAWAL OF A BLOOD SPECIMEN

a. **General.** Occasionally during an operation, the surgeon may wish to have a blood specimen collected. Although this procedure is not done to administer a drug, it also requires a venipuncture. The specialist may be required to withdraw the specimen.

b. **Procedure.** Procedure for withdrawal of blood differs from that described for intravenous injection in the following respects:

(1) A dry, sterile syringe is used; the appropriate size for the amount of blood to be withdrawn. Place the plunger in the closed or zero position at the start of the procedure.

(2) When the needle is in the vein, withdraw the necessary amount of blood, leaving the tourniquet in place.

(3) When the blood has been withdrawn, release the tourniquet, cover the injection site with a sterile pad, withdraw the needle, and press the pad firmly over the puncture site for several minutes to prevent the extravasation of blood.

3-44. INTRAVENOUS INFUSION TECHNIQUE

a. **Definition.** Intravenous infusion is the introduction of large amounts of fluids into a vein to replace or maintain blood or other body fluids such as electrolytes (body salts), and nutrients.

b. **Fluids Used.** Fluids administered by IV infusion include whole blood transfusion, dextran, serum albumin, normal saline solution, and glucose solution. During an operation, IV infusions are often administered by venous cutdown.

c. **How Supplied.** Blood is supplied in plastic bags or glass flasks. The other fluids mentioned above are supplied in glass bottles especially constructed to facilitate IV infusion of their contents. An infusion bottle is closed with a metal seal and a special 2-hole rubber stopper. The holes are sealed with rubber blanks that are easily perforated. Inside the bottle, a glass tube extends from the smaller of the two holes in the stopper to near the bottom of the bottle.

d. **Role of the Circulator.** The specialist assists the anesthetist by assembling the necessary equipment, preparing it, and assisting during the venipuncture. If ordered, the specialist will start the IV infusion. In paragraphs 3-45 and 3-46, a description is given of the equipment necessary, as well as the procedure for preparing and giving the infusion.

3-45. PREPARATION FOR INFUSION

a. **General.** Constant improvement is being made in the technique and equipment used in IV therapy. One improvement is the disposable injection set currently used (see figure 3-10 A); it has a built-in airway which only requires insertion into the rubber-stoppered solution bottle (see figure 3-9 B).

(1) The solutions are available in presterilized bottles ready for use, and sealed under vacuum. The solutions must be free from all sediment or crystalline particles. In preparing an intravenous infusion, check each bottle of solution for clarity. Discard those solutions that seem cloudy or appear to contain particles of any type.

(2) The first step in preparation for infusion is to obtain all the needed items--the solution, intravenous injection set, adhesive tape, alcohol sponges, tourniquet, standard to hold the solution flask, and an armboard if necessary.

b. **Assemble the Intravenous Injection Set and Solution.** The OR specialist proceeds as follows:

(1) Stand the supply bottle upright. Remove the metal cap and discs from the solution flask. The surface of the stopper is sterile at this point; however, if touched by the hand or another object, it should be cleansed with a sponge and alcohol. Leave the sponge in place on the stopper.

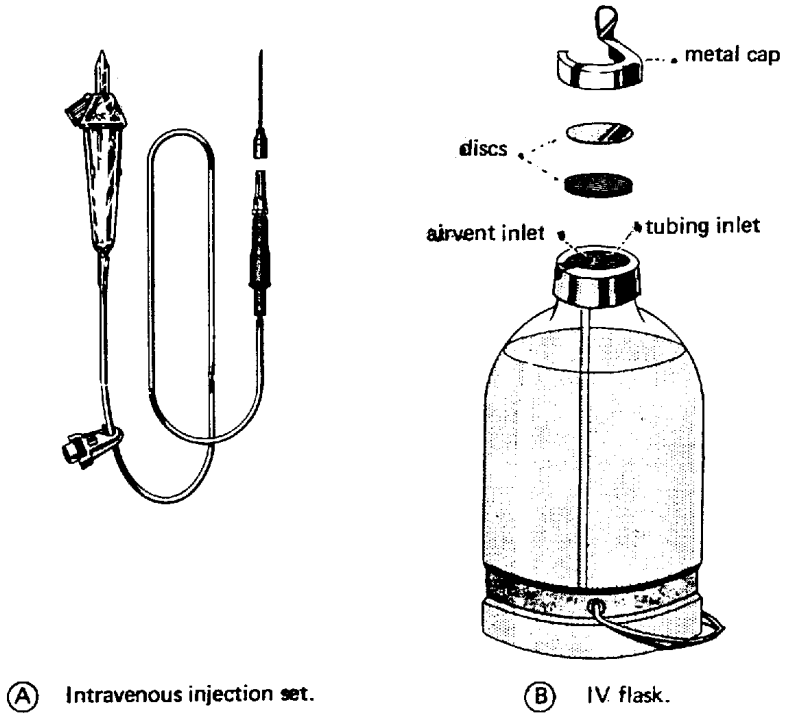


Figure 3-10. Intravenous injection set and IV flask.

(2) Open the disposable IV injection set; straighten the tubing.

(3) Check to see if there is an airvent needle in the IV set and a venipuncture needle attached to the adapter. If not, select a size 18 needle for the airvent and a size 19 or 20 needle for the venipuncture.

(4) Discard the alcohol sponge (if used).

(5) Identify the airvent inlet flow (see figure 3-10 **B**) and the tubing inlet on the flask. The airvent communicates with the glass tube. Insert the airvent needle into the airvent inlet. There should be a sound of air; and bubbles, indicating the presence of vacuum, should appear in the solution; if this does not occur, discard the flask and obtain a new one.

(6) Remove the protective plastic seal from the tip of the drip chamber on the IV injection set. Using moderate pressure and a twisting movement, insert tip in the tubing inlet.

(7) Place control clamp below the drip chamber. Close the clamp.

(8) Invert and suspend the flask on the IV standard elevating it about two feet above the patient's arm.

(9) Expel the air from the tubing: Hold the needle adapter over a basin, remove and save the protector cap, release the clamp and allow the solution to run through the tubing into the basin. Close the clamp, and replace the needle protector cap. Loop the needle end of the tubing over the flask until venipuncture is done.

3-46. **INTRAVENOUS INFUSION**

a. Select and prepare the site as for IVand apply a tourniquet. If neither antecubital site can be used, or if simultaneous, multiple infusion setups are required, veins on the back of the hand or on the dorsum of the foot may be used. The limb selected should be immobilized to prevent possible damage to it by the needle on movement of the limb.

b. Remove the protective cap and insert the needle into a vein as for IV injection. Blood in the tubing near the needle hub confirms venipuncture.

c. Open the clamp and allow the fluid to flow into the vein.

d. Place a small bit of material such as cloth or gauze between the hub of the needle and the skin in order to help keep the needle tip in the lumen and away from the wall of the vein. Secure the needle in place with the adhesive tape.

e. Watch the drip chamber and adjust the flow to the rate ordered by the anesthetist. Rate of flow is noted by observing the drip chamber of the infusion set and by counting the number of drops per minute.

(1) To regulate the rate of flow, know the number of drops per milliliter (ml) delivered by the IV set used and the number of ml per minute that the patient is to receive. (Read the instruction on the carton in which the disposable IV set is packed to determine the number of drops per ml delivered by the set to be used.)

(2) To calculate the rate of flow in drops per minute to be maintained, divide the total amount of solution to be given by the total number of minutes and multiply by the number of drops per milliliter delivered by the IV set used.

Example:

500 ml is to be given in 1 1/2 hours (90 minutes).
The set is calibrated to 10 drops per ml.
500 ml divided by 90 = 5.55 per minute.
5.55 X 10 drops per ml = 55.5 or 56 drops per minute.

Therefore, regulate the drip device by adjusting the clamp to deliver 56 drops per minute for a period of approximately 1 1/2 hours.

(3) If the rate of flow is not maintained as desired, inform the anesthetist or surgeon. If so instructed, adjust the clamp.

f. When the drip chamber is almost empty, terminate the infusion by clamping the tube.

g. Remove the needle and care for the site as in intravenous injection technique.

h. Discard the used infusion set.

i. Do not save or reuse any partially filled bottles of fluid because they are considered contaminated.

3-47. OBSERVATION OF THE PATIENT DURING INFUSION

The patient is under the direct observation of the anesthetist throughout the surgical procedure. However, the specialist should assist the infusion site if it is obstructed from the anesthetist's view. If swelling occurs at the site, notify the anesthetist and stop the infusion.

a. Watch for any signs of reactions.

b. Watch the patient's color.

c. Take the pulse frequently.

d. Clamp the tubing and report immediately if the patient complains of feeling chilly or if shivering occurs.

3-48. VENOUS CUTDOWN

a. **General.** Sometimes there is great difficulty in entering the vein and venisection or surgical venous cutdown must be done. This incision is for the purpose of threading a cannula into the vein of the tissues overlying a vein (the preferred site is the foot). The cannula may be either a needle or a length of polyethylene tubing. The procedure is done using aseptic technique and sterile equipment.

b. **Equipment Needed.**

(1) Sterile gloves.

(2) Cutdown tray. Usually a cutdown set is kept in the operating suite. The contents of the cutdown set may vary somewhat, according to local policy. However, all include items needed to open a vein using sterile technique, plus a blunt-point needle for insertion into the vein. (A polyethylene catheter may be preferred in lieu of a needle.) The equipment is arranged on a small sterile table or stand.

(3) Protective device. Placement of a device such as a ladder splint over the foot will prevent pressure on the cannula and on the foot, safeguarding patency when the sterile drapes are placed.

c. **Specialist's Duties.** The circulator proceeds as follows:

(1) Shaves the area selected for the cutdown if the ankle or other hairy site is chosen.

(2) Opens the cutdown set on a small stand.

(3) Pours into a medicine glass the solution ordered for preparation of the patient's skin.

(4) Checks, with the scrub, the label on the local anesthetic solution, if any is ordered, and then transfers the desired amount into a sterile medicine glass, using the technique described in paragraph 3-7a(5) and (6).

(5) Places a ladder splint or other protective device over the foot, which is used after the cannula is secured in place by the medical officer.

d. **Procedure.** The skin over the vein is prepared aseptically and may be draped with towels or a small fenestrated sheet. The surgeon, wearing gloves, injects the local anesthetic solution, then he makes an incision one- fourth to one-half inch long. He then isolates the vein and brings it to the surface by placing a hemostat under it. The surgeon opens the vein with a small nick, inserts the needle or catheter into the vein, and secures it to the vein wall with a stitch. The skin incision is closed and a dressing is applied.

3-49. BLOOD TRANSFUSION

a. **General.** Blood transfusion is the transfer of whole blood from one person (the donor) to another (the recipient). During most surgical procedures, the transfusion is delayed (also called indirect). Using the indirect method, the blood is drawn from the donor into a specially prepared receptacle (plastic bag) containing a citrate solution to keep it from clotting. It may then be stored at 4 degrees to 6 degrees centigrade for a period of time not exceeding 21 days.

b. **Purpose.** Whole blood is given to maintain the patient's circulating volume of blood and his blood pressure and to preserve the blood's oxygen-carrying capacity. Blood is transfused as is indicated by the blood loss sustained by the patient during the course of surgery or by his general condition during surgery. (If the patient goes into shock, he is usually given a transfusion.)

c. **Whole Blood Supplies.**

(1) Container. Whole blood is supplied in 500 ml plastic-pack units or 500 ml glass flasks. They are referred to as units (500 ml) of blood.

(2) Label on blood bag. The label contains information that includes the donor's blood group (O, A, B, AB), the Rh type (positive or negative), result of serology test, date the blood was collected, and the expiration date.

(3) Blood recipient set (see figure 3-11). This is a disposable set, similar to that illustrated in figure 3-10 A (IV injection set), except that the blood recipient set has a built-in filter to remove any clumped cells.

3-50. TRANSFUSIONS DURING SURGERY

a. **Indications.** A transfusion may be given during the course of any type of surgery, major or minor, when the patient's condition indicates the need for whole blood.

b. **Specialist's Duties.** Since the circulator assembles the materials and assists the anesthetist as necessary in starting the transfusion, it is essential that the OR specialist be familiar with the process of obtaining and administering the blood and with certain other considerations in the giving of blood as follows.

c. **Requisition of Blood.** To obtain blood, the requisition form (SF 518) (see figure 3-12) is made out in triplicate; the patient's blood is grouped (O, A, B, AB), typed (Rh positive or negative), and is cross-matched with blood of the same group and Rh type. Usually two copies of the transfusion requisition form must accompany the blood to the OR suite, and these forms are filled out by the anesthetist, who attaches them to the patient's chart. When blood is brought to the OR suite, it is placed in the refrigerator until ready to be given. The specialist may be assigned to get the blood.

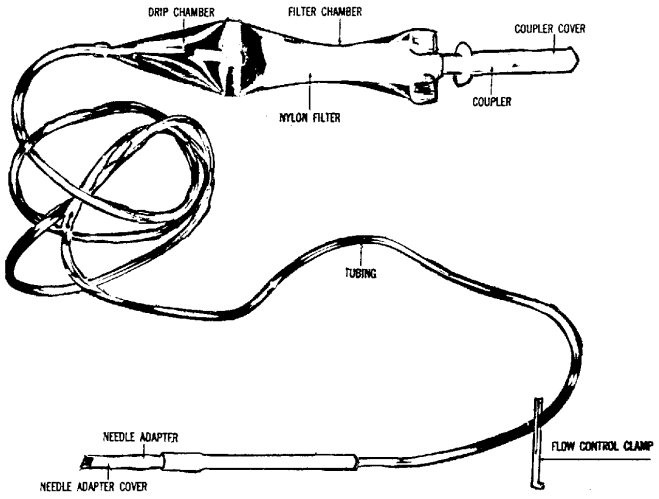


Figure 3-11. Blood recipient set.

d. **Multiple Site Transfusions.** When the condition of the patient warrants, the anesthetist may start two or more units of blood at different sites to run simultaneously. Trans-fusions given at more than one site may be infused by using needles, by venous cutdown, or by using a combination of the two methods.

e. **Procedure in the Administration of Blood.** A blood transfusion is started using the procedure as set forth for intravenous infusions, with the following exceptions:

(1) Use an infusion set with a filter. (Unfiltered blood is never given.)

(2) Obtain the blood from the refrigerator. Two persons will again check the label against the transfusion requisition and will note the appearance of the blood (usually the anesthetist and the circulator will do this).

(3) Do not warm the blood unless specifically ordered to do so. Blood may be given at the temperature at which it is received from the laboratory or blood bank.

(4) Rotate the unit of blood gently to disperse the cells evenly. Do not shake the blood, as this will damage the red cells.

(5) Have a sterile 2 ml syringe and a large gauge needle (17- to 19-gauge) ready. The anesthetist may wish to use the syringe to accomplish the venipuncture. After blood appears in the syringe, remove the syringe from the needle and attach the tubing.

(6) Place an inflatable cuff (such as a blood pressure cuff) around the plastic bag of blood when the blood is ordered given under positive pressure. Inflate the cuff as ordered.

f. **Special Precautions.**

(1) When pressure is being applied to the blood to speed the rate of transfusion, the bag must be kept under constant observation. As soon as the bag contains less than a quarter of its total contents, the pressure must be released. These precautions are observed to prevent the occurrence of air embolism, which could prove fatal to the patient.

(2) Whenever feasible, separate sites should be used for glucose and blood.

★U.S.GPO 1985-0-483-515/2679

MEDICAL RECORD | **BLOOD OR BLOOD COMPONENT TRANSFUSION**

SECTION I—TRANSFUSION REQUISITION

☐ RED BLOOD CELLS ☐ OTHER (*Specify*)	UNITS OR_____ML	DATE REQUESTED	DATE AND HOUR WANTED	PHYSICIAN
KNOWN IMMUNE ANTIBODY FORMATION ☐ Rh ☐ Others	PREVIOUS TRANSFUSIONS ☐ Yes ☐ No ☐ Unknown		REACTIONS TO PREVIOUS TRANSFUSIONS ☐ Unknown ☐ No ☐ Yes (*Type*)	
DIAGNOSIS	IF PATIENT IS FEMALE, IS THERE HISTORY OF ☐ Hemolytic Disease of Newborn ☐ RhIG Treatment ☐ Stillbirth ☐ Miscarriage ☐ Delivery			

REMARKS (*Pertinent Patient History*)

I have taken a blood specimen on the below named patient, verified the name, and verified the specimen tube label.

SIGNATURE

VERIFICATION SIGNATURE (*If required*)

PATIENT SIGNATURE (*or verifier if patient unable to sign*)

SECTION II—BLOOD TYPE, COMPATIBILITY INFORMATION AND CERTIFICATION

UNIT NO.	TRANSFUSION NO.	COMPATIBILITY INFORMATION			
			SALINE	ALBUMIN	COOMBS
DONOR	RECIPIENT	MAJOR (*DC/PS*)			
ABO TYPE	ABO TYPE	MINOR (*PC/DS*)			
Rh TYPE	Rh TYPE	☐ Compatibility Tests Not Performed (*Explain below*)			
		REMARKS:			

SIGNATURE (*Person performing tests*)	DATE	SIGNATURE (*Verifier, if required*)

SECTION III—RECORD OF TRANSFUSION

ADMINISTRATION				POST TRANSFUSION DATA	
DATE OF TRANSFUSION	MONTH	DAY	YEAR	AMOUNT GIVEN_____ML	TIME COMPLETED/INTERRUPTED
TIME STARTED				REACTION: ☐ NONE ☐ SUSPECTED	

IDENTIFICATION:

I have examined the blood or blood component container label and blood or blood component transfusion form and I find that all information identifying the container with the intended recipient matches item by item. The recipient is the same person named on this blood or blood component transfusion form and on the patient identification tag.

☐ YES ☐ NO

If reaction is suspected—IMMEDIATELY:
1. Discontinue transfusion; treat shock if present, keep intravenous open
2. Notify Physician and Transfusion Service
3. Follow transfusion reaction procedures

DESCRIBE: ☐ URTICARIA ☐ CHILL/FEVER ☐ HEMOLYSIS/PAIN

RECORD: Temp._____ Pulse_____ B/P_____

Other difficulties (*equipment, clots, etc.*) ☐ No ☐ Yes (*Specify*)

VERIFIED BY	SIGNATURE OF PERSON STARTING TRANSFUSION	SIGNATURE OF PERSON NOTING ABOVE

PATIENTS IDENTIFICATION—USE EMBOSSER—(*for typed or written entries give: Name—Last, first, middle, rank/rate; hospital number and name of facility.*) | SEX | WARD NO.

BLOOD OR BLOOD COMPONENT TRANSFUSION

STANDARD FORM 518 (REV. 9-76)
Prescribed by GSA and Interagency Committee on Medical Records
FPMR (41 CFR) 101-11.806-8
518-118

MEDICAL RECORD COPY

Figure 3-12. SF 518 (Blood or blood component transfusion).

g. **Malfunctionings.** While the transfusion is running, the anesthetist keeps a close watch on the patient's condition for evidence of a reaction. The circulator shares in the responsibility of observing the transfusion equipment. Any malfunction must be brought immediately to the attention of the anesthetist. Blood may stop running for several reasons. Some of the reasons are:

(1) The lumen of the needle presses against the wall of the vein.

(2) The hub of the needle loosens on its fitting, causing the blood to leak around it.

(3) The lumen of the tubing kinks or is occluded by other means (such as being caught between the armboard and a scrubbed person who presses against the armboard).

(4) A small clot forms distal to the tip of the needle.

(5) A spasm (contraction of muscles) interferes with the venous infusion site.

(6) The needle used is of too small a caliber. For this reason, needles used for transfusion are of the largest gauge that will enter the lumen of the vein (18- or 19-gauge are the smallest generally used for transfusion.

Continue with Exercises

EXERCISES, LESSON 3

INSTRUCTIONS. Answer the following exercises by marking the lettered response that best answers the question or best completes the incomplete statement or by writing the answer in the space provided.

After you have completed all of these exercises, turn to "Solutions to Exercises" at the end of the lesson and check your answers. For each exercise answered incorrectly, reread the material referenced with the solution.

1. Tablets of drugs to be prepared for injection should be dissolved in which of the following sterile containers?

   a. Syringe.

   b. Sealed vial.

   c. Medicine glass.

   d. Solvent bottle.

2. In addition to name, strength, and expiration date, what information should you check for on the label of a drug before preparing a dosage for an IV injection?

   a. Manufacturer's name.

   b. What side effects the drug has.

   c. Whether the drug may be injected.

   d. Whether the drug may be given intravenously.

3. When venous cutdown is performed using the patient's foot or ankle as the site, a protective device, such as a ladder splint should be placed over the site. The function of the ladder splint is to

   a. Protect the sterile drapes.

   b. Protect the sterility of the cannula.

   c. Protect the sterility of the O.R. table.

   d. Safeguard the patency when the drapes are placed.

4. Which of the following statements represents the procedure that is done for venipuncture for withdrawal of a blood specimen, but is NOT done for venipuncture for the administration of medication?

   a. The tourniquet is left in place during the procedure.

   b. An alcohol sponge is used to prepare the patient's skin.

   c. The tourniquet is removed as soon as the needle enters the vein.

   d. Citrate solution 10 ml should be injected into the vein just prior to withdrawal of the blood specimen.

5. Which of the following factors may predispose to cardiac arrest?

   a. Anoxia of the heart muscle.

   b. Moving the patient during induction.

   c. Toxic reaction to the anesthetic agent.

   d. Giving an overdosage of drugs preoperatively.

   e. All of the above.

6. Which item is part of a nasal-pack tray used to give anesthesia?

    a. 10 ml control syringe.

    b. Coryllos retractor.

    c. Bayonet forceps.

    d. Emesis basin.

SITUATION for exercises 7 and 8. You are the circulator for an operation, and you are assisting the anesthetist.

7. What should you do, or assist in doing, just prior to induction of anesthesia?

    a. Guard any apparatus connected to the patient, when he is being transferred from litter to table.

    b. Place a small pillow under the patient's back and another beneath his knees.

    c. Ensure that the patient's legs are uncrossed.

    d. Ensure that the patient is wearing a cap.

    e. All of the above.

8. What should you do, or assist in doing, during induction of anesthesia?

    a. Fasten the leg strap.

    b. Arrange the sheet or blanket over the patient.

    c. Assist in the maintenance of quiet in the room.

    d. Arrange the patient's head to a desirable position.

9. Members of the OR team perform a routine check in an effort to ensure that the patient receives the blood intended for him. The procedure used for this purpose is:

    a. Have the laboratory perform a second type and cross match just prior to administration of the blood.

    b. Check label on the blood bag against laboratory reports of the patient's CBC and Hb.

    c. Telephone the blood bank and confirm information on the label of the blood bag.

    d. Check label on the blood against information on the transfusion requisition.

10. What item(s) should the circulator obtain when the patient develops laryngospasm?

    a. Vasopressor drugs.

    b. An endotracheal tray.

    c. A cardiac arrest tray.

    d. Respiratory stimulants.

11. A reaction to a drug other than that generally obtained following administration of a drug is called:

    a. Analgesia.

    b. Idiosyncrasy.

    c. Hypertoxicity.

    d. Hypersensitivity.

12. When an anesthetic agent is administered by local infiltration, how is it given?

    a. Injected into the tissue around the operative area.

    b. Applied on a membranous surface in the operative area.

    c. Injected intravenously into a vein in the operative area.

    d. Filtered through a gauze mask placed over the patient's nose and mouth.

13. What stage of anesthesia is most likely to be characterized by breath-holding?

    a. I.

    b. II.

    c. III.

    d. IV.

14. When a surgeon administers either local infiltration or topical anesthesia, the person who usually records the necessary information on the patient's chart is the:

    a. Operating room supervisor.

    b. Circulator.

    c. Surgeon.

    d. Scrub.

15. For purposes of recording, the patient's local anesthesia begins with accomplishment of which of the following events?

    a. Making of the incision.

    b. Initial loss of sensation.

    c. Beginning of surgical anesthesia.

    d. Initial administration of anesthetic.

16. Which of the following signs are symptomatic of laryngospasm?

    a. Coughing, gasping, or uneven respiration, and cyanosis.

    b. Absence of blood pressure, intermittent respiration, and cyanosis.

    c. Rapid drop in blood pressure, weak pulse, and increase in pulse rate.

    d. Frequent swallowing, increase in pulse rate, and rapid respirations.

17. Which of the following would likely result if preanesthetic medication were administered to a patient the night before his scheduled surgery?

    a. Patient would reveal an increase in metabolic rate.

    b. Patient's thirst would be quenched.

    c. Less anesthesia would be required.

    d. Patient would go into a coma.

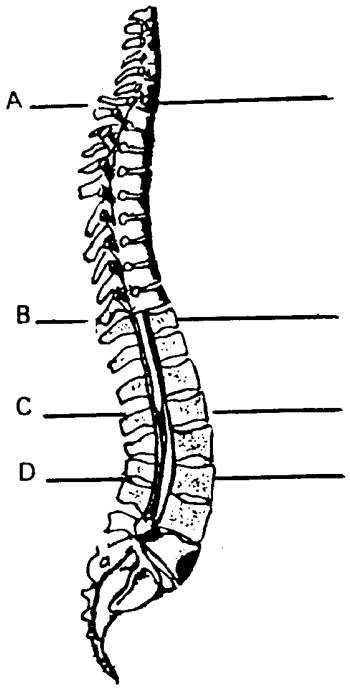
18. Spinal anesthesia is usually injected at which of the following levels?

    a. A.

    b. B.

    c. C.

    d. D.



19. When you circulate for regional block anesthesia, one of your important duties concerns the arrival of the patient in the OR. What do you do?

    a. Notify the anesthetist when the patient is brought into the OR suite.

    b. Notify the surgeon when the patient is brought into the OR suite.

    c. Go for the patient at such time that he will arrive in the OR no later than 10 minutes before the operation is scheduled to start.

    d. Send for the patient at such time that he will arrive in the OR no later than 1 1/2 hours before the operation is scheduled to start.

20. Unless the surgeon or the anesthetist orders otherwise, at what temperature should blood be administered?

    a. The temperature to which it is warmed by leaving it in water at 130ºF for 15 minutes.

    b. The temperature it is received from the blood bank.

    c. Body temperature.

    d. Room temperature.

21. Vomiting is a dangerous complication during the administration of anesthesia. The initial problem with vomiting is that it predisposes the patient to which of the following conditions?

    a. Circulatory collapse.

    b. Respiratory failure.

    c. Cardiac arrest.

    d. Aspiration.

Situation for exercises 22 through 26. During an operation being performed using general anesthesia, the patient goes into shock. You are the circulator.

22. What should you do?

    a. Begin giving the indicated treatment.

    b. Begin giving artificial respiration.

    c. Assist the anesthetist as directed.

    d. Leave the room and get assistance.

23. Which of the following agents should be given to the patient?

    a. Oxygen.

    b. Nitrous oxide.

    c. Carbon dioxide.

    d. None of the above.

24. Certain drug items that may be used to treat the patient who is in shock are included under which of the following categories?

    a. Narcotics.

    b. Vasopressors.

    c. Vasodilators.

    d. Muscle relaxants.

25. Which of the following categories of drugs are frequently used for the patient in shock?

    a. Analgesics.

    b. Antihistaminics.

    c. Intravenous barbiturates.

    d. Intravenous replacement fluids.

26. How should the patient who is in shock be positioned to facilitate treatment?

    a. Lateral recumbent.

    b. Face floorward.

    c. Side-lying.

    d. Head skyward.

    e. Head low.

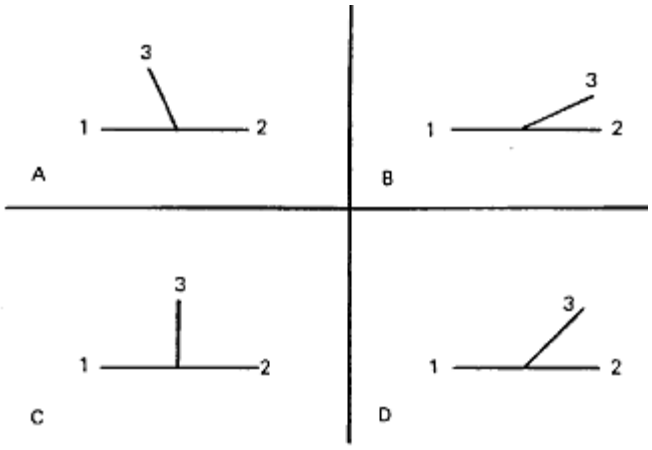
27. In each of the drawings, the line labeled 1 and 2 represents the surface of the patient's skin and the line labeled 3 represents the shaft of the needle. Which drawing best represents the angle at which the needle should be inserted for an I.M. (intramuscular) injection?

    a. A.

    b. B.

    c. C.

    d. D.



For Exercises 28 through 33. Each numbered item in Column I can be matched **BEST** by one of the lettered choices in Column II. You may use any choice in Column II for as many exercises as you wish; however, there is only **ONE BEST** answer to each exercise.

COLUMN I: Identifying Characteristics

__ 28. Probably the lease toxic injectable local anesthetic.

__ 29. Will support combustion, but will not explode.

__ 30. Local agent not useful for topical anesthesia.

__ 31. Administered either IV or rectally.

__ 32. Supplied in compression cylinders.

__ 33. Has almost no analgesic action.

COLUMN II: Anesthetic Agents

a. Lidocaine.

b. Nesacaine.

c. Tetracaine.

d. Thiopental sodium.

e. Nitrous oxide.

Check Your Answers on Next Page

SOLUTIONS TO EXERCISES, LESSON 3

1. c (para 3-37b(1), (7))
2. d (para 3-42b)
3. d (para 3-48b(3)
4. a (para 3-43b(2)
5. e (para 3-31d)
6. c (para 3-8c(1)(b)
7. e (para 3-21a(1), (3), (4), (5))
8. c (para 3-21b(1), (2))
9. d (para 3-50c, e(2))
10. b (para 3-32d(1))
11. b (para 3-2f(1))
12. a (para 3-6a)
13. b (para 3-23b)
14. b (para 3-7c)
15. d (para 3-7c)
16. a (para 3-32c)
17. c (para 3-4b(1))
18. d (para 3-10f, figure 3-2)
19. a (para 3-9d)
20. b (para 3-50e(3)
21. d (para 3-33)

22. c (para 3-34d)

23 a (para 3-34b(1)

24. b (para 3-34b(4))

25. d (para 3-34(b)(2))

26. e (para 3-34b(3))

27. c Drawing C depicts the shaft of the needle at a 90° angle (perpendicular to the skin. This is the proper angle for intramuscular injection since the needle must penetrate thick muscle. (para 3-40b(4)

28. b (para 3-16)

29. e (para 3-26c)

30. b (para 3-16)

31. d (para 3-27b)

32. e (para 3-26a, d)

33. d (para 3-27c)

End of Lesson 3

LESSON ASSIGNMENT

LESSON 4	Procedures in General Surgery.
TEXT ASSIGNMENT	Paragraphs 4-1 through 4-16.
LESSON OBJECTIVES	After completion of this lesson, you should be able to:
	4-1. Identify procedures used in a sponge count.
	4-2. Identify the responsibilities of the scrub and of the circulator in the following surgical procedures: skin graft, debridement, excision of pilonidal cyst, herniorrhaphy, appendectomy laparotomy, gastrectomy, colostomy, \ cholecystectomy, ligation, and excision of varicose veins, thyroidectomy, and hemorrhoidectomy.
SUGGESTION	After completing the assignment, complete the exercises at the end of this lesson. These exercises will help you to achieve the lesson objectives.

LESSON 4

PROCEDURES IN GENERAL SURGERY

4-1. INTRODUCTION

a. **Scope**. The surgical specialty that includes the majority of cases performed in the OR is general surgery; therefore, it is essential that the OR specialist know what his duties are when assigned to scrub or circulate for general surgical procedures. General surgery encompasses the basic practice of the operative treatment of disease. Although not all general surgical procedures are included in this discussion, the others not discussed may be handled efficiently by the OR specialist if he will make the necessary adaptations to meet the needs of the particular patient.

b. **Classification.**

(1) As operations became more numerous and complex, surgical specialties developed out of general surgery which facilitate operations on specific areas of the body. Thus, plastic surgeons perform cosmetic and reconstructive surgery on the skin and certain soft tissues. Orthopedic surgeons operate on bones, joints, and tendons. Neurosurgeons operate on the nervous system: brain, spinal cord, and peripheral nerves. Ophthalmologists are specialists in eye surgery and otorhinolaryngologists in ear, nose, and throat surgery. Operations on the urinary system and male reproductive system are performed by urologists. Gynecologists operate on the female reproductive system. Thoracic surgeons operate on the lungs, heart, great vessels, and the esophagus; however, a cardiovascular surgeon is more specialized in procedures pertaining to the heart and great vessels and operates on these organs.

(2) In addition to the previously mentioned surgical specialties, general surgeons, too, have their own specific areas of the body to treat. Surgery classified as general includes the following categories: surgery of tissues of the limbs, the head and neck, the trunk (certain operations), the abdominal wall, the gastro-intestinal tract, the accessory digestive organs, the peripheral blood vessels (not including the intrathoracic great vessels), the lymphatic system, the endocrine glands, the breasts, and surgery of the anus and rectum. In addition, the kind of defect and the reason for surgery must be considered. For example, wound debridement of the muscular tissue of a limb is classed as general surgery, but operation on the same musculature to correct a postural defect is classed as orthopedic surgery. In other words, body areas and structures are useful as reference points but not as absolute lines of demarcation for the classification of surgical procedures. In the following text, general surgical procedures included in each of the above classifications except surgery of the lymphatic system and surgery of the breasts are discussed.

4-2. SURGERY OF THE SKIN

The area of skin prepared preoperatively, the type and placement of drapes, and the position of the patient all depend upon the location of the pathology (head, neck, limbs, or the trunk). For example, if several small lesions are scheduled for excision, multiple prepping and draping are done. The choice of anesthesia depends upon the kind and extent of pathology. The instruments and sutures needed depend upon the kind, location, and depth of the pathology. Local policy and the surgeon's preferences are followed. In the following paragraph, discussion of a specific operation on the skin is set forth, with emphasis on the duties of the OR specialists.

4-3. SKIN GRAFT

a. **Discussion.** Skin lost (caused bthermal or other injury) may be replaced with skin obtained by either homograft (taken from another person) or autograft (taken from the patient). If an autograft is to be used, both the donor site and the recipient site must be prepped and draped. In the operation described below, an autograft is taken from the anterior surface of the right thigh and placed on the left arm.

b. **Preparation of the Patient.** Either general or local anesthesia may be used depending upon the needs of the situation.

(1) Prep. The specialist assigned to shave the patient preoperatively should exercise the greatest care to avoid nicking the skin, especially that of the donor site. The prep done immediately preoperatively is as has been discussed (see para 1-12).

(2) Position. The circulator is to place the patient in a modified supine position with the recipient arm on an armboard.

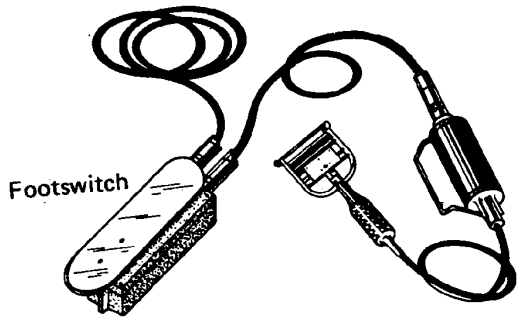
(3) Drape. The surgeon and "sterile" team members drape the patient as described for draping of the limbs for general surgery.

c. **Preparation of the Operating Room.** Instruments and other items for the procedure are selected in accordance with information on the instrument card. These include either a dermatome (electric or hand) or a skin grafting knife if a free graft is to be taken. The scrub is to set up a separate table for equipment needed to remove the graft. Items to be placed on the table are as follows:

(1) Dermatome or knife. If an electric dermatome (see figure. 4-1) is used, it should be checked for proper functioning by scrub and circulator.

(2) Medicine glass.

(3) Tongue blades.



Figureure 4-1. Dermatome.

(4) Applicators.

(5) Mosquito forceps.

(6) Corrosion resistant steel basin.

(7) Normal saline.

(8) Gauze sponges.

(9) Fine mesh gauze sponge (for placement on the donor site).

(10) Sterile mineral oil.

d. **Care of the Graft.** Care of the graft is the duty of the scrub. He should perform the following procedures:

(1) Take the skin off the dermatome.

(2) Uncurl edges of skin and flatten it on a gauze sponge moistened with saline.

(3) Place it on a flat surface.

(4) An inverted flat pan is good for this purpose.

(5) Place the excised skin not used for grafting in a sterile container of penicillin solution, cover the container, and put in the refrigerator, if ordered.

(6) Save any unused portion of the skin graft until ordered to dispose of it.

e. **Suturing Types Usually Used.** Plain catgut size 2-0 or 3-0--used for ties. Black silk size 4-0 on affixed needle--used for suturing the graft in place.

4-4. DEBRIDEMENT OF SOFT TISSUE WOUND OF THE THIGH

a. **Discussion.** Surgical debridement is a mechanical, physical cleansing of a wound. Extensive damage to muscles and adjacent soft tissues may be present when there is traumatic injury to soft tissues. The continued presence of devitalized tissues in the patient may give rise to serious complications and result in death. Accordingly, soft tissue wounds are treated by the wide and deep excision of all devitalized tissues (tissues that do not bleed promptly upon incision). Because the procedure selected for discussion involves only the soft tissue, it is done as a general surgical procedure. If a fracture were continuous with the wound, the procedure would be performed as an orthopedic surgical procedure. However, the specialist assigned to scrub or circulate for debridement has duties similar to those described below no matter what may be the area of body involvement or the surgeon's clinical specialty.

b. **Special Preparation of the Operating Room.**

(1) Instruments. The instruments needed include tissue forceps, scissors for both tissue and sutures, scalpels, dressing forceps, hemostats, retractors, needle holders, and sponge-holding forceps. The sizes of instruments should be appropriate for the body area involved; the number of each included depends upon the extent of the area to be debrided and upon the preference of the surgeon.

(2) Other equipment needed.

(a) Irrigating set.

(b) Asepto syringe.

(c) Medication cups (2).

(d) Metal basin.

(e) Gauze sponges, fluffed gauze, and fine mesh gauze (plain or Vaseline gauze).

(f) Distilled water.

(g) Normal saline.

(h) Detergent or soap.

(i) Soft hand brush.

(j) Fluids for infusion.

(k) Infusion standard.

(l) Bucket.

(m) Plastic sheeting.

(n) Adhesive strips.

(o) Plaster cast setup, if ordered.

(p) Splint, if ordered.

c. **Preparation of the Patient.**

(1) The patient is anesthetized. The clothing is then cut away over a large area, and dressings and temporary splints are removed (the circulator is to assist as ordered during this procedure). A pad of sterile gauze is held firmly over the wound while the skin over a large area adjacent to the wound is thoroughly cleansed with soap and water and is painstakingly shaved. The entire circumference of the limb is prepared. The circulator is to have the necessary supplies at hand for the prep, and he is to assist with the prep as ordered.

(2) The circulator and the necessary number of "non-sterile" assistants place the patient in the desired position for surgery when instructed to do so. The circulator is to put a tourniquet in place, if ordered. Sterile drapes are placed as set forth previously (see para 1-27c).

d. **Immobilization of Limb.** Even when no fracture is present, the surgeon may elect to immobilize the injured limb upon completion of surgery. Immobilization is done to rest the part, to maintain correct positioning, and to promote healing. Immobilization may be done by splints or by well-padded plaster casts. A plaster cast that encircles the limb is to be cut (as marked by the surgeon) as soon as the plaster has set. The procedure of cutting the cast is never to be postponed. The circulator cuts the cast if ordered.

e. **Special Precautions.**

(1) The precautions discussed for positioning the patient should be observed (see para 1-13e(1)-(4). In particular, the specialist should be deliberate and gentle in maneuvering the patient, as the patient is susceptible to both shock and hemorrhage.

(2) The adhesive strips applied over the dressing upon completion of surgery must not encircle the limb. Encircling adhesive could act as a tourniquet when the limb swells postoperatively, as it invariably does. This precaution is especially necessary if a plaster cast is used.

(3) Frequently, the doctor will order an antitetanus injection.

f. **Handling of Specimens.** Unless ordered otherwise, the circulator is to process tissue excised as a specimen for the laboratory.

g. **Suturing Types Usually Used.** Absorbable sutures in a size desired by the surgeon are used for ligatures and suture ligatures. Other sutures are not required at this time because the wound in the limb is left open and is closed later (within 4 to 7 days after injury) by third intention. It may be allowed to heal by secondary intention. When debridement and hemostasis have been completed, the surgeon places strips of fine mesh gauze transversely across the wound, and then he packs fluffed gauze loosely in the pocket formed by the strips. A gauze dressing is then laid over the gauze in the wound and adhesive tape is applied either longitudinally or spirally (see precaution,
e(2), above). The scrub or the circulator applies the tape if ordered to do so.

h. **Suturing After Debridement of Other Body Areas.** All debrided wounds are left widely open, without suturing of the deep tissues or the skin, except for the following (in all cases, sutures are of a type and size prescribed by the surgeon):

(1) Face wounds. These are closed primarily.

(2) Sucking chest wounds. The muscle is closed over a sucking chest wound following excision of devitalized tissue. The skin is left open.

(3) Head injuries. The dura and the scalp are closed primarily. If the dura is opened, stay sutures are placed in its edges.

(4) Hand injuries. These are closed primarily. Sutures of very fine silk and nylon are used.

(5) Injury of the joint capsule or synovial membrane. The joint capsule or the synovial membrane is closed; the subcutaneous tissue and the skin are left open.

4-5. EXCISION OF PILONIDAL CYST AND SINUS

a. **Discussion.** A pilonidal cyst may be formed by a malformation (congenital) caused by a defect in the formation of the vertebral column or by invagination of the ectoderm (during fetal development) at the sacrococcygeal region. Repeated mild trauma of the sacrococcygeal region may result in this type of penetration. Since military personnel often ride over rough terrain while sitting on a hard surface, they are especially susceptible to pilonidal disease. Infection of a pilonidal cyst may result in the formation of a sinus tract.

b. **Indication.** Excision is indicated for patients who suffer repeated attacks of inflammation requiring incision and drainage and have not responded to conservative management.

c. **Prep, Position, and Drape.** The preoperative skin preparation includes the area of the perineum and the lumbar region (see figure 1-1). The jackknife position is used with a modified laparotomy drape (see figure. 1-16).

d. **Instruments.** A minor dissecting set usually suffices for this excision.

e. **Special Considerations.**

(1) A large curette is usually included to scrape the base of the wound to remove all gelatinous tissue.

(2) Methylene blue dye should be available in the room because at times the surgeon needs to inject it to trace the sinus tract.

(3) If the dye is needed, syringes and a blunt needle are required to inject the dye. The circulator provides the scrub with these items.

(4) Absorbable suture (plain or chromic) size 0 or 1 may be used for ligatures and suture-ligatures.

(5) If infection is present, the wound may be left open to heal by secondary intention. Packing is usually inserted and a bulky dressing carefully applied.

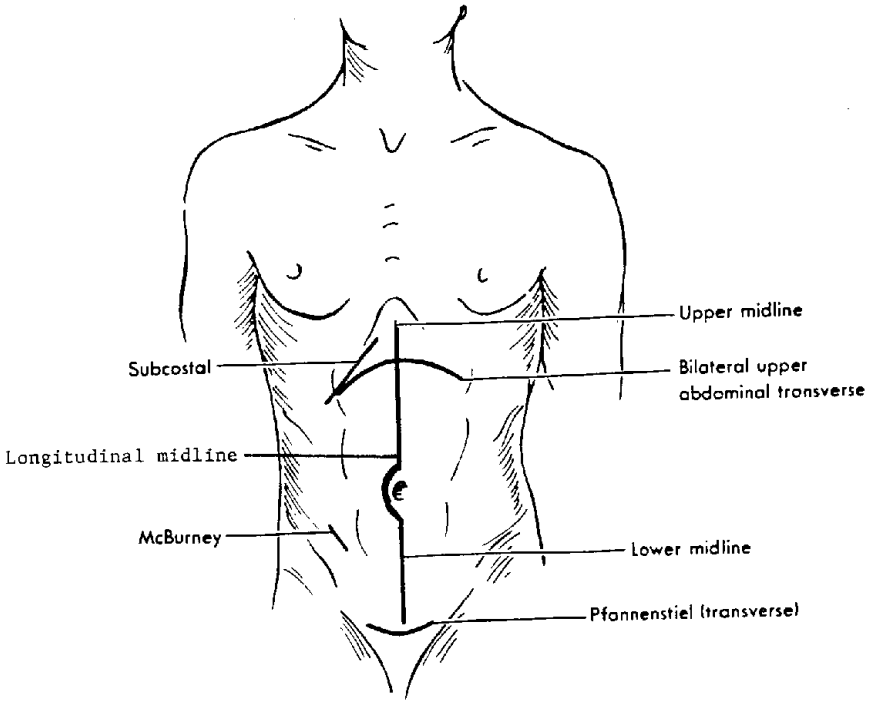
f. **Handling of Specimen.** Tissue excised and scrapings of tissue obtained by curettage are to be processed as specimens.

4-6. COMMON SITES FOR ABDOMINAL INCISIONS (FIGURE 4-2)

a. The paramedian rectus incision may be used for operations in the upper, mid, or lower abdomen on the right or left side. The incision is made parallel to the midline, about four cm lateral to it.

b. The longitudinal midline incision may be used for gastrectomy, resection of the colon, for penetrating wounds of the abdomen, and for abdominal operations on women. The incision is made through the linea alba in the upper or lower abdomen. The incision may be extended by curving it around the umbilicus.

c. The McBurney (muscle-splitting) incision may be used for appendectomy, cecostomy, and for drainage of appendiceal or pelvic abscess. A similar incision may be made on the left side for a sigmoid colostomy or for repair or a hernia. The incision is made about 8 cm long and is made parallel to the fibers of the external oblique muscle and fascia.



Figureure 4-2. Abdominal incisions.

d. The upper quadrant oblique (sub-costal) incision, when used for operations on the gallbladder, common duct, or the pancreas, is made on the right side. The incision is made on the left side when it is to be used for splenectomy. For this incision, the anterior sheath and rectus muscles are cut transversely.

e. The inverted "U" incision may be used for gastrectomy, resection of the transverse colon, and operations of the gallbladder and its ducts. This incision divides the rectus muscle transversely.

4-7. SPONGE COUNT

a. **Discussion.** A sponge count is done in order to account for all sponges put on the sterile table for use during an operation when the depth or location of the operative area is such that a sponge could be accidentally lost or left in a patient.

b. **Types of Cases for Which a Sponge Count is Taken.** A sponge count is routinely taken for all operations done inside the abdominal or chest cavity. Local policy may prescribe that a sponge count be done routinely for hernia repair and for thyroid surgery. In addition, a count is taken for other types of cases, including the following:

(1) Operations of the hip or shoulder joint.

(2) Operations on the spine.

(3) Radical surgery of the breast.

(4) Major vaginal surgery.

(5) Any operation upon request of the surgeon.

c. **Procedure.** In the following text, a procedure for taking the sponge count is set forth. The specialist should check local policy concerning the sponge count and adhere to it exactly.

(1) When the scrub opens a package of sponges, he is to remove pins and strings. (The exception to this procedure is that Kitner sponges are left on the safety pin for counting.)

(2) The scrub is to pick up a pack of sponges with one hand and shake them slightly so that they will separate easily for counting.

(3) The scrub and the circulator are then to count the sponges simultaneously with the scrub counting aloud. Both the scrub and the circulator must see each sponge. Therefore, the scrub is to separate each sponge from the pack while counting and stack the counted sponges on the table. A registered nurse (RN) is required to witness all sponge counts in the OR.

(4) Both the scrub and the circulator are to check each sponge for opaque marking (sponges used must be opaque to roentgen rays, except for Kitner sponges, which do not have opaque marking).

(5) The scrub is to separate laparotomy (lap) sponges for counting, and he is to open each one fully so that he and the circulator may check each for opaque marking.

(6) If the scrub and the circulator do not agree on the count, they must take it again.

(7) If a package contains an incorrect number of sponges or a sponge without opaque marking, the circulator is to remove the entire pack from the room immediately and obtain another package.

(8) The circulator is to record the count on a sponge-count board, or in the place specified by local policy. If additional sponges are needed during the case, they are counted and recorded in the same manner.

(9) The surgeon will request subsequent sponge counts. Again, the scrub, the circulator, and the RN must see each sponge. The sponges in the various areas are counted separately (those discarded, those on the sterile tables, and those in the operative field) and then added to obtain the total count. The sequence used in the sponge count is: start with the sponges around the incision; then sponges on the Mayo tray; then sponges on the back table; and finally, the discarded sponges. The procedures are as follows:

(a) The circulator used forceps to point to each sponge on the paper.

(b) The scrub is to handle the sponges remaining on the back table, separating each as it is counted so that he, the circulator, and the RN can see each sponge.

(c) The surgeon may assist in counting the sponges remaining in the operative field.

(d) The three counts are added and should total the number recorded for the initial count plus any additional sponges that were opened during the case.

(e) The scrub is to report the result of the sponge count to the surgeon: if the count is correct, he will proceed with the closure of the wound. If the count is incorrect, all sponges are to be recounted at once. The circulator is to check the kick bucket and the floor, and he will often need to don rubber gloves to see that all sponges are separated; the surgeon may assist in recounting sponges in the operative area, and the scrub is to check the instrument tables.

(f) If the count remains incorrect after the recount, the OR supervisor, who is notified, normally assists with another recount. An X-ray of the operative area may be ordered. If so, it will be taken with portable X-ray equipment while the patient is still on the operating table.

d. **Rules for the Scrub.**

(1) Keep the sponges together on the back table. Do not scatter them, tuck them under towels, use them to wrap specimens, nor for any other purpose except sponging.

(2) Place all sponges for use inside the cavity on a sponge forceps. Never hand a loose sponge while the cavity is open.

e. **Rules for the Circulator.**

(1) Before the first count is taken, remove from the room all wrappers and sponges that are not to be included in the count. After the first count has been taken, see that no sponge or linen of any kind is removed from the room until the operation has been completed and the final sponge count has been certified correct.

(2) Keep the discarded sponges collected throughout the case. Do not allow a large number of used sponges to accumulate. Shake lap sponges carefully to make sure that no gauze sponges are adhering to them.

(3) Put the collected sponges in the place provided for them. Local policy in various hospitals may set forth other methods for the storage of used sponges during an operation. One method is as follows: place a piece of wrapping paper in a designated area on the OR floor. Place the sponges on this paper in rows and in groups according to the kind of sponge. This method facilitates the taking of the final count.

4-8. ABDOMINAL WALL HERNIOPLASTY (HERNIORRHAPHY)

a. **Discussion.** Abdominal hernia is a protrusion of an internal structure through an abnormal opening in the abdominal wall. It occurs because of weakness in the musculature of the wall. Hernioplasties comprise a large share of elective general surgical cases. (Elective cases are those performed when the patient is in his best possible condition for surgery, at a time convenient for the surgeon and the hospital.) Hernias may be congenital or acquired, and they may be classified according to both type and anatomical location.

b. **Types of Hernias.** Hernias may be reducible or irreducible.

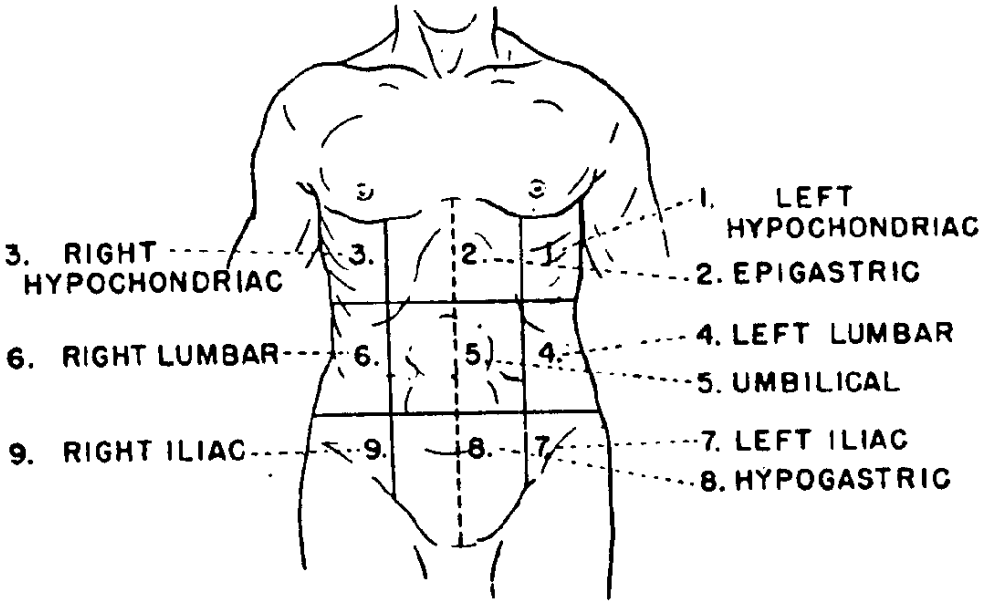
(1) Reducible. The viscera can be restored by manipulation. A recurrent, reducible hernia is repaired as a scheduled (elective) procedure.

(2) Irreducible. Irreducible is a hernia that cannot be restored manually. As a result, a portion of the viscera has its blood supply blocked by compression, and the hernia becomes strangulated (incarcerated). An incarcerated hernia requires emergency surgery.

c. **Anatomical Location of Hernias.** Included in this classification are hernias referred to as inguinal, ventral, and incisional hernias.

(1) Inguinal hernia. This is the most frequently occurring hernia, accounting for 70 to 75 per cent of all abdominal wall hernias, and it is 10 times more common in men than in women. It occurs in the area of the inguinal canal (in the groin), the weakest part of the abdominal wall. Inguinal hernioplasty is discussed in d below, as an example of abdominal wall hernioplasty.

(2) Ventral hernia. This term indicates that there is a protrusion through the abdominal wall. An epigastric hernia is a more specific term indicating a protrusion above the umbilicus, and umbilical hernia, a protrusion through the umbilicus (see figure. 4-3). These hernias characteristically occur in middle-aged men who work at manual labor (epigastric hernia) and in obese men (umbilical hernia).



Figureure 4-3. Regions of the abdomen.

(3) Incisional hernia. The incisional hernia is a hernia that develops in the scar of a surgical incision. The hernia may occur after the surgery before healing is complete or long after surgery due to weakening of the abdominal wall at the site of the incision. Frequently, wound infection results in incisional hernia.

d. **Inguinal Hernioplasty.**

(1) Instruments and equipment. A minor laparotomy set including Babcock forceps is used, plus a Penrose drain to retract the spermatic cord, abdominal suction tip and rubber tubing connection, and small Richardson retractors for general retraction. Kitners or moist gauze sponges are also used for blunt dissection.

(2) Preparation of the patient. Either spinal or general anesthesia may be used. The specialist is to assist with the administration of anesthesia as previously discussed in lesson 3. The patient is placed in a supine position. An abdominal prep is done, and a laparotomy drape is used.

(3) Preparation of suction. Upon completion of draping, the scrub attaches the rubber tubing connection for the abdominal suction to the laparotomy sheet and secures it with a sterile Allis forceps. The scrub then places the suction tip on the tubing. The circulator attaches the free end of the tubing to the suction machine and

turns the machine on. The scrub places the suction tip in a basin of sterile saline or water to test the suction. The circulator then turns the suction machine off until it is needed. The scrub and the circulator should set up and test suction apparatus in accordance with this procedure regardless of the operation for which suction is to be used.

(4) Special consideration. Because of the inguinal anatomy and the opening of the peritoneal cavity, a sponge count is taken as prescribed by local policy for all hernia repairs.

(5) Surgical incision. The incision is usually about 4 inches long and 1 1/2 inches deep.

(6) Handling of specimen. The excised hernia sac is processed as a specimen and is sent to the laboratory.

(7) Suturing types usually used.

(a) Absorbable gut sutures (plain or chromic) size 3-0 or 2- 0--used to ligate bleeding vessels.

(b) Nonabsorbable sutures, such as silk size 2-0 or cotton size 0—on Murphy needle size 3--used to ligate the hernia sac.

(c) Nonabsorbable sutures, such as silk or cotton size 2-0 or 3-0--12-inch lengths--on Mayo needle size 4--used for the plastic reconstruction of the anatomic defect.

(d) Absorbable gut sutures size 3-0, or silk size 3-0-- interrupted sutures on Murphy needle size 3--used to close the subcutaneous tissues.

(e) Silk size 4-0 or nylon size 5-0 straight skin needles-- used to close the skin.

4-9. APPENDECTOMY

a. **Discussion.** One of the most common procedures of elective general surgery performed inside the abdominal cavity is an appendectomy or the removal of the vermiform appendix, a worm-shaped projection from the cecum. Some pathological conditions require appendectomy, which are: gangrenous appendix, appendicitis with fecalith (concretion formed around fecal matter), retrocecal (behind the cecum) appendix with appendicitis, and appendiceal abscess. A sponge count is taken for appendectomy.

b. **Surgical Approach.** Because the appendix is located at the junction of the ileum and the cecum, it is approached most frequently through a McBurney incision about 3 to 4 inches long, near the iliac crest (about one-third the distance between the crest of the ilium and the umbilicus).

c. **Equipment Needed.** A minor laparotomy set (see para. 4-10c(2)) of instruments is needed, plus Babcock forceps which are used for holding the mesoappendix and appendix. A suction tip and rubber tubing connection are included in the setup.

d. **Prep, Position, and Drape.** The usual prep for a McBurney incision extends from waist to pubis. The patient is placed in supine position, and a laparotomy drape is used. The scrub sets up the sterile suction equipment; the scrub and the circulator test the equipment.

e. **Special Item Needed.** The gastrointestinal suture is used for the "purse-string" suture around the stump of the appendix.

f. **Handling of Specimen.** The circulator is to process the specimen for the laboratory.

g. **Suturing Types Usually Used.** The type and size of sutures used for an appendectomy are determined by the surgeon. The following are usually used:

(1) Absorbable gut size 3-0 or 2-0--ligatures.

(2) Gastrointestinal suture affixed on curved needle--purse-string.

(3) Absorbable gut size 3-0 on curved, cutting-edge needles--used to close peritoneum and fascia.

(4) Silk size 3-0 on straight skin needle--used to close skin.

4-10. LAPAROTOMY

a. **Discussion.** This is a general term indicating that the abdominal cavity is to be entered surgically. It does not indicate the therapeutic procedure performed, nor does it indicate the site of the surgical incision. If the surgeon is uncertain of the specific procedure to be done, he may have the operation scheduled as an exploratory laparotomy. As an example, a missile entering the right hypochondriac region (see figure 4-3) of the abdomen and exiting directly posteriorly may have damaged any or all of these organs: liver, gallbladder, right flexure of colon, small intestine, and right kidney. The operative procedure is changed during surgery according to the pathology found. For example, if the patient is found to have a ruptured gastric ulcer, the operative procedure is changed to read "Laparotomy for repair of gastric ulcer." A sponge count is taken for laparotomy.

b. **Prep, Position, and Drape.** General anesthesia is employed, and an abdominal prep is done. The patient is placed in supine position and the position is modified as may be necessary upon determination of the pathology. A laparotomy drape is used and is usually placed for midline incision (see figure 4-2 B).

c. **Instruments.** A major instrument set also known as a major laparotomy set is used, with large self-retaining retractors and specific instruments for resections and anastomoses. Crushing clamps may be used on portions of the digestive system to be permanently resected. On structures to be anastomosed, a rubber-shod Doyen clamp is preferred to avoid excessive trauma. An abdominal suction setup is to be prepared.

(1) A major laparotomy set contains a variety of instruments to include larger sizes of the basic instruments. The major laparotomy set, because of its completeness, could be used alone or in conjunction with a specialty set for the majority of intra-abdominal operative procedures.

(2) A minor instrument set known also as a minor laparotomy set differs from the major instrument set in that the former contains fewer and smaller instruments. The minor laparotomy set is the preferred instrument set for less major intra-abdominal operative procedures such as an appendectomy or hernia repair.

d. **Handling of Specimens.** Any tissue excised is to be processed as a specimen unless the surgeon directs otherwise.

e. **Suturing Types Usually Used.** Sutures included in the setup are those for ligatures and for closure of the wound, as described for appendectomy (see para 4-9i). If the surgeon meets with pathology in the abdomen that requires the use of additional types of sutures and needles, he will request the needed items.

4-11. GASTRECTOMY

a. **Discussion.** This means the removal of the stomach, but in use, the term is used to indicate either the removal of a part of the stomach (partial gastrectomy or subtotal gas-trectomy) or the removal of the entire stomach (total gastrectomy). The surgeon tries to leave at least a small part of the upper portion of the stomach intact. Gastrectomy is the surgical treatment for cancer or other neoplasms and for ulcer. These conditions are diagnosed preoperatively by X-ray.

b. **Anesthesia, Prep, Position, Drape, and Instruments.** These are the same as for a laparotomy. A sponge count is taken for gastrectomy.

c. **Special Considerations.** When gastrectomy is performed, normal gastrointestinal continuity is interrupted. In order to re-establish this continuity, the surgeon does an anastomosis.

d. **Gastrointestinal Anastomosis** (see figure 4-4). This is the attachment of one tubular structure to another to create a passage through the two parts. An anastomosis may be made either side-to-side or end-to-end. Sutures used for the anastomosis are of silk (size 4-0 to 3-0) or cotton (size 4-0) affixed on intestinal needles. Because the intestine has been opened, contamination occurs and some special considerations may be observed. These are as follows.

A
End-to-end anastomosis.

B
Side-to-side anastomosis.

Figure 4-4. Gastrointestinal anastomoses.
(Arrows indicate direction of flow of intestinal contents.)

(1) Double setup.

(a) Extra gowns, extra gloves, and draping linens are placed on a separate table and covered with a double thickness sterile sheet.

(b) Extra instruments and extra sponges are set up on a separate table.

(2) Procedure. When the anastomosis is completed, all instruments are removed from the area, all sponges and laparotomy tapes are removed from the patient's abdomen, and the wound is covered with a fresh, moistened, laparotomy tape. The top drape is then removed. The surgeon and all other "sterile" workers change their gowns and gloves. The circulator helps uncover the extra instruments. The patient is draped with a new sterile laparotomy sheet and the abdominal wound is closed. Sutures used for closure are as described for appendectomy.

4-12. COLOSTOMY

a. **Discussion.** This is the surgical creation of an artificial opening into the colon and mobilization (exteriorization) of the portion of bowel affected. A sponge count is required for this operation.

b. **Indications.** Colostomy is done when there is an obstruction of the colon or a diagnosed lesion such as malignant tumor, which will result in obstruction if untreated. Colostomy may also be done to enable the healing of the bowel distal to the surgical opening whenever there is infection, perforation, or traumatic injury, because the colostomy diverts the flow of feces from the area of surgical pathology.

c. **Types.** A colostomy may be either temporary or permanent.

(1) Temporary colostomy. A temporary colostomy is done to divert the feces from its normal course for a long enough time to allow healing, to relieve an obstruction, or to serve as a palliative measure. A loop of colon is brought through the abdominal wall and the skin and underlying tissues are sutured around it. A device made of a glass rod and rubber tubing may be used to prevent the colon from slipping back into the abdominal cavity. The rod is left in place until the wound is well healed (about 10 days). A catheter may be secured in the proximal part of the loop of colon for immediate decompression.

(2) Permanent colostomy. A permanent colostomy is done to redirect the flow of feces in conjunction with surgery such as removal of the rectum. This type of colostomy consists of a single, small opening in the abdominal wall with a portion of bowel (cut transversely) brought through it; usually, this is the end of the sigmoid colon.

d. **Preparation of the Patient.** Anesthesia, prep, position, and drape are as described for laparotomy.

e. **Preparation of the Operating Room.** Instruments are as set forth for laparotomy, with the addition of the following items: two glass rods, soft rubber tubing, rubber tube drain, Vaseline gauze, and catheters of the desired size and type. Soft rubber tubing is used to retract the colon.

f. **Special Precautions.** Whenever the large bowel is opened intentionally or accidentally, there is always the possibility of contamination and infection of the abdomen because of the presence of E. coli in the bowel; therefore, special precautions are taken as indicated by local policy. These may include isolation of the bowel area with extra large laparotomy tapes, isolation of instruments used for the resection of the bowel, and the changing of all members of the sterile team into fresh gown and gloves once the colostomy has been done.

g. **Requirements.** This isolation technique requires extra linen, instruments, and possibly the set-up of an additional Mayo stand. It assures the carrying out of good aseptic technique in that no so-called "dirty" (contaminated) instruments are used on other parts of the abdomen for the final closure.

h. **Suturing Types Usually Used.** Sutures for ligation of bleeding vessels are as described for appendectomy. Chromic gut size 2-0 affixed on curved, taper-point needles is used to close the peritoneum beneath the loop of the colon. The fascia and skin are sutured beneath the loop. Silk size 3-0 may be used for this purpose.

4-13. CHOLECYSTECTOMY

a. **Discussion.** Cholecystectomy is the surgical removal of the gallbladder. This procedure is usually performed due to chronic cholelithiasis (formation of stones in the gallbladder), which results in inflammation and abdominal pain. A sponge count is required for this operative procedure.

b. **Prep, Position, and Drape.** The surgical prep extends from the nipple line to the pubis (abdominal prep); the patient is placed in a reverse Trendelenburg position (see figure 1-7), and a laparotomy drape is used.

c. **Special Considerations and Instruments.** The location of the gallbladder under and partly adherent to the liver makes it a difficult organ to reach. Incisions frequently used are the upper quadrant oblique (subcostal) incision, the right (paramedian) rectus incision, and the inverted "U" incision (see figure 4-2). The same major instrument set is used for laparotomy. For the special needs of this surgery, the following items are added:

(1) Curved Kelly forceps to hold Kitner sponges, which are used to assist the surgeon in blunt dissection from the liver bed.

(2) Scoops and spoons that are especially adapted for the removal of stones from the gallbladder.

(3) Gallstone forceps, used to clamp the gallbladder and to extract stones from the common duct. Common duct dilators are also included in the setup.

(4) A sterile T-tube for insertion into the common bile duct after removal of the gallbladder and a sterile Penrose drain for placement in the abdominal incision.

d. **Special Procedure.** The surgeon may wish to have a cholangiogram done to check the common duct for patency. A cholangiogram is the X-ray visualization of the biliary duct after the injection of a contrast medium. This procedure would be performed to locate possible obstruction in the common bile duct. Contrast media (hypaque or diodrast) is injected into the duct system and X-rays are taken. Supplies needed include a syringe, blunt needle, and a polyethylene tubing. A cassette holder must be placed on the table under the patient before surgery begins.

e. **Suturing Types Usually Used.** Ligatures for bleeding vessels are used as for appendectomy.

(1) Chromic gut size 0 or silk size 2-0 affixed on curved needles is used to suture the peritoneal fold which overlies the liver after the fold is clamped and divided.

(2) Chromic gut size 0 and 2-0 is used to ligate the cystic duct and cystic artery.

(3) Chromic gut size 1 or 0--suture-ligature is used to ligate bleeding vessels in the area of the cystic duct and cystic artery. The wound is closed using materials as described for closure after appendectomy.

4-14. SURGERY FOR VARICOSE VEINS

a. **Discussion.** Varicosities usually involve the saphenous vein. Surgery performed on varicose (unnaturally swollen) veins is the most common type of elective surgery performed as treatment for disorders of blood vessels.

(1) A distension or back-pressure affects the veins in the lower limb, thus causing venous stasis (stoppage of the flow of blood). The techniques involved, including procedures of the saphenous vein, have enabled surgeons to save limbs that formerly would have been amputated because of gangrene caused by obstruction. The interruption or removal of diseased veins aids in prevention of ulceration, pain, and fatigue in the limb.

(2) The prep includes the entire leg and groin region. The patient is placed in either a supine or a semi-lateral position, according to local policy or the surgeon's preference. The affected leg is slightly abducted, the knee flexed, and the leg and foot are supported on a padded rest. There are two methods of doing surgery: ligation and excision. These are discussed in paragraphs b and c below.

b. **Ligation of Varicose Veins.** In this procedure, multiple small incisions may be made over each area of knotted veins, and the vein and its branches are ligated (tied).

(1) Special items needed in the setup of the OR are: one injection set, including syringe, needle file, and medication (sclerosing agent); and elastic bandages, used as a part of the dressings following surgery.

(2) Local anesthesia is usually used. The patient is draped as described for the general surgery drape of limb (see para 1-27).

(3) Absorbable gut suture (plain) size 3-0 or silk size 4-0 may be used to ligate bleeding subcutaneous vessels. Absorbable gut suture (chromic or plain) size 2-0, 0, or 1, or silk size 3-0 or 2-0 on a size 3 Murphy needle may be used to ligate the saphenous vein and its branches. (After the saphenous vein has been ligated, its distal portion is injected with the sclerosing solution.) The fascia and subcutaneous tissues are then closed, using interrupted sutures of plain gut size 0, or chromic size 2-0, or silk size 3-0 on a size 3 Murphy needle. The skin is closed using silk size 4-0 on straight needles.

c. **Excision of Varicose Veins.** The saphenous vein, a superficial one, is ligated and excised for treatment of extensive varicosities of the lower limb. During this procedure, the saphenous vein is stripped. This is done by inserting a vein stripper in the saphenous vein immediately distal to the sapheno-femoral junction at the upper thigh, and passing it down the vein to the knee and subsequently to the ankle, thus stripping the vein free of its attachments in the leg. The vein is then doubly tied and removed.

(1) Special items needed in the setup include: vein retractors, Weitlaner self-retaining retractors, a vein stripper, and elastic bandage.

(2) Anesthesia is as for saphenous vein ligation (b(2) above). The patient is draped as described for the orthopedic drape of a lower limb (refer to Lesson 1, figure 1-17).

(3) Ligatures are as used for ligation of the saphenous vein. The saphenous vein is exposed and ligated (at the sapheno-femoral junction), using the materials for suture-ligatures as described above. The end of the saphenous vein distal to the point of ligation is then threaded onto the vein stripper and the stripper is pushed downward to a point near the knee. A second small incision is then made near the knee. The vein is delivered through this opening and is doubly tied or transfixed using absorbable suture (chromic size 0 or plain size 1) or silk size 1 or 0 on a size 3 Murphy needle. Segmental removal of the vein is continued to the ankle. Upon completion of the vein stripping, the wound layers are closed using the suture materials set forth in paragraph 4-14b(3).

4-15. THYROIDECTOMY

a. **Discussion.** Thyroidectomy is removal of part or all of the thyroid gland. While the thyroid gland is not essential to life, it is important in iodine metabolism, and maintenance of metabolic rate to keep the body healthy. An indication for surgery is hyperthyroidism (excessive functional activity characterized by increased basal metabolism). It is associated with enlargement of the thyroid gland. A sponge count may be taken for this operation according to local policy.

b. **Special Items Needed.** In addition to the standard setup, the following items should be included:

(1) Dye or a length of suture. For cosmetic reasons, the surgeon may wish to mark the incision line with a dye or by pressure using a length of suture.

(2) Small hemostats. Although thyroid surgery is not deep, it is performed in a vascular area, and therefore requires the use of a great number of small hemostats.

(3) Cardiac arrest tray and tracheostomy tray. The circulator should have these items in the room.

c. **Preparation of the Patient.**

(1) Preoperative preparation. Pre-operatively, the male patient is instructed to shave his face as usual. The OR specialist does the remainder of the prep--the neck and upper chest to the nipple line. The immediate preoperative prep is as described previously (refer to lesson 1, paragraph 1-12).

(2) Position. The reverse Trendelenburg position is used (refer to Lesson 1, figure 1-7) with the neck hyperextended by a rolled sheet placed lengthwise between the scapulae.

(3) Drape. Draping presents a problem because the operative field is so close to the anesthetist and the unsterile field. A Mayo table or a special wire screen can be used above the patient's face to support the weight of the drapes and extend them. In addition, keeping the skin towels in the proper position may prove difficult. For this reason, the surgeon may wish to sew the skin towels in position using a cutting edge needle and heavy (number one) black silk. The scrub should have the suture ready in case the surgeon requests it. Skin towels may also be clipped to the skin.

d. **Handling of Specimen.** The circulator is to process the excised thyroid tissue as a specimen.

e. **Suturing Types Usually Used.**

(1) Absorbable suture (plain size 2-0 or chromic size 3-0) or silk size 4-0--ligatures.

(2) Silk size 2-0 or chromic gut size 0--suture-ligatures for the superior thyroid vessels and the inferior thyroid artery.

(3) Chromic gut size 0 or silk
size 3-0 threaded or affixed on size 1 Murphy needles--used as mattress sutures to approximate the pretracheal muscles if they have been divided.

(4) Absorbable sutures (plain size 2-0 or chromic size 2-0) or silk size 4-0 threaded or affixed on size 3 Murphy needles--interrupted-- subcutaneous tissue.

(5) Silk size 4-0 affixed on needles or threaded on Keith needles--skin closure.

4-16. HEMORRHOIDECTOMY

a. **Discussion.** Hemorrhoidectomy is the excision of dilated veins in the rectum. These veins are excised and ligated to control bleeding and to relieve pressure and pain. Either spinal or general anesthesia may be used.

b. **Preparation of the Patient.**

(1) Prep. The rectal area, perineal area, and the buttocks are prepared extending to mid-thigh on the posterior aspect of the legs (refer to Lesson 1, figure 1-1).

(2) Position. The patient is placed in either a jackknife or lithotomy position.

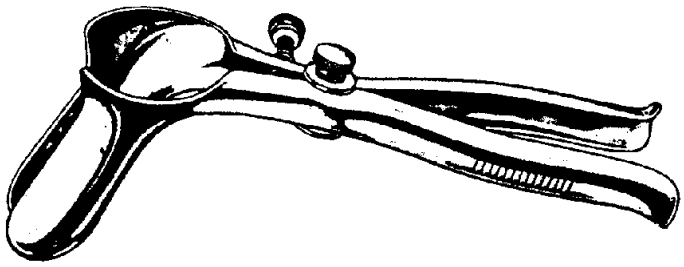
(3) Drape. Draping is dependent upon the position used.

c. **Special Considerations.**

(1) Some surgeons precede hemorrhoidectomy with a sigmoidoscopy examination. The sigmoidoscopy setup is made ready with a rectal speculum (see figure 4-5) and lubricant.

(2) The surgeon uses absorbable sutures of chromic catgut to close the incision that has been made through the anal mucosa, thus eliminating the need to remove the sutures later.

(3) The surgeon inserts a petrolatum gauze packing directly into the rectum.



Figureure 4-5. Rectal speculum, Pratt 8 1/2 inch.

Continue with Exercises

EXERCISES, LESSON 4

INSTRUCTIONS. Answer the following exercises by marking the lettered response that best answers the question or best completes the incomplete statement or by writing the answer in the space provided.

After you have completed all of these exercises, turn to "Solutions to Exercises" at the end of the lesson and check your answers. For each exercise answered incorrectly, reread the material referenced with the solution.

1. What complication of surgery often results in incisional hernia?

   a. Pneumonia.

   b. Evisceration.

   c. Wound infection.

   d. Wound disruption.

2. Healing of tissues following excision of an infected pilonidal sinus or cyst is by which of the following methods?

   a. Primary intention.

   b. Secondary intention.

   c. Third intention.

   d. None of these.

3. An appendectomy is being performed and you are the scrub. Gastrointestinal suture is included in the setup for appendectomy. You should hand this suture when the surgeon is ready to:

   a. Anastomose the colon.

   b. Close the peritoneum.

   c. Place the purse-string.

   d. Anastomose the ileum and the cecum.

4. Temporary colostomy may be done to enable the healing of the portion of the colon that is distal to what point?

   a. Umbilicus.

   b. Hepatic flexure.

   c. Splenic flexure.

   d. Exteriorized colon.

5. Prior to inguinal hernioplasty, the rubber tubing connection for an abdominal suction apparatus should be attached to the laparotomy sheet using which of the following items?

   a. Towel forceps.

   b. Allis forceps.

   c. Safety pin.

   d. Hemostat.

6. A portion of colon has been cut transversely and brought through a small opening in the patient's abdominal wall. What surgical procedure does this best describe?

   a. Laparotomy.

   b. Permanent colostomy.

   c. Temporary colostomy.

   d. Gastrointestinal anastomosis.

SITUATION for exercises 7 thru 9. You are the scrub during a cholecystectomy procedure.

7. What kind of a sponge should you offer when the surgeon is ready to perform blunt dissection of the gallbladder from the liver bed?

   a. Kitner.

   b. 2 x 2.

   c. 4 x 4.

   d. 4 x 8.

8. Before the operation started, the surgeon instructed you to have ready a syringe, a blunt needle, contrast medium, and polyethylene tubing. What procedure discussed in this lesson requires the use of these items?

   a. Exploration of the common duct.

   b. Aspiration of the hepatic duct.

   c. Drainage of the cystic duct.

   d. Cholangiogram.

9. Into what instrument should you affix a sponge to be used for blunt dissection?

    a. Crile forceps.

    b. Allis forceps.

    c. Sponge forceps.

    d. Curved Kelly forceps.

10. How should a limb be draped for excision of the saphenous vein?

    a. As for a minor procedure, using sterile towels.

    b. As for orthopedic surgery of a lower limb.

    c. As for general surgery.

    d. Should not be draped.

11. When total gastrectomy is performed, what additional surgical procedure is necessary?

    a. Gastrointestinal anastomosis.

    b. Cholecystectomy.

    c. Appendectomy.

    d. None.

12. You, (the circulator) are placing equipment needed for a thyroidectomy in the OR. Which of the following trays should also be placed in the room?

    a. Venous pressure tray.

    b. Resuscitation tray.

    c. Tracheostomy tray.

    d. Prep tray.

13. Which of the following tasks should the circulator do to assist in setting up an abdominal suction apparatus in preparation for inguinal hernioplasty?

    a. Attach tubing to laparotomy sheet.

    b. Attach tubing to suction machine.

    c. Test the suction.

    d. All of the above.

14. A curette is usually included in the setup for excision of pilonidal sinus or cyst. For what reason does the surgeon use the curetter?

    _____

15. A surgeon precedes hemorrhoidectomy with a sigmoidoscopy. A sigmoidoscopy setup includes lubricant and a _____:

SITUATION for exercises 16 and 17. You are the scrub during a hemorrhoidectomy procedure.

16. What suture materials should you prepare?

    a. Chromic catgut.

    b. Plain gut.

    c. Cotton.

    d. Silk.

17. What dressing should you have available for the surgeon's use upon completion of the procedure?

    a. 4 x 4's.

    b. Dry gauze packing.

    c. Petrolatum gauze packing.

    d. Gauze packing moistened with saline.

SITUATION for exercises 18 and 19. You are the circulator on an operation done to debride a thigh wound with the patient suffering a degree of shock.

18. Which of the equipment listed below should NOT be placed in the OR?

    a. Fluids for infusion.

    b. Fluids for drinking.

    c. Normal saline.

    d. Irrigating set.

    e. All of the above.

19. The surgeon completes the debridement and dresses the patient's wound. Which of the following medications should be ordered for injection?

    a. Cocaine.

    b. Ethylene.

    c. Mephenytoin.

    d. Antitetanus injection.

20. What suture materials may be required for closing when a pilonidal cyst or sinus is excised?

    a. Chromic--1.

    b. Wire--20 gauge.

    c. Cotton--3-0.

    d. Silk--2-0.

21. Surgery of the tissues of an arm is normally done by a(n):

    a. Orthopedic surgeon.

    b. General surgeon.

    c. Gynecologist.

    d. Neurosurgeon.

SITUATION for exercises 22, 23 and 24. You are the scrub for a skin-grafting operation for which an autograft is to be taken. A dermatone is used.

22. Which of the following items should be included in a setup on a separate table for the removal of the graft?

    a. Retractor.

    b. Kelly forceps.

    c. Dressing forceps.

    d. Fine mesh sponge.

23. When the surgeon has excised the graft, what should you do with it first?

    a. Uncurl its edges.

    b. Remove it from the dermatone.

    c. Put it in a CRS basin containing saline.

    d. Roll it in a sponge moistened with saline.

24. When a wound is debrided, all devitalized tissues should be excised. Tissue may be identified as devitalized by which of the following characteristics?

    a. Bleeds profusely promptly upon incision.

    b. Does not bleed promptly upon incision.

    c. Has a whitish color.

    d. Has a reddish color.

Situation: Exercise 25 is based on the drawing below. The incision is the line labeled a and b.

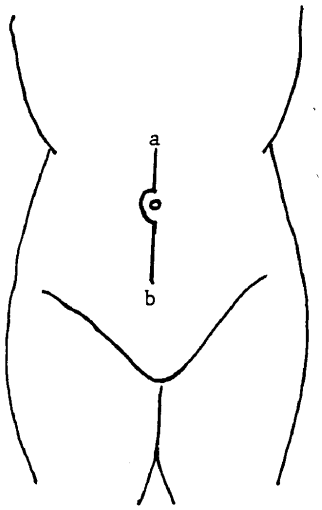
25. What is the incision depicted below?

    a. Upper quadrant oblique.

    b. Longitudinal midline.

    c. Paramedian rectus.

    d. Inverted "U."



1

Check Your Answers on Next Page

SOLUTIONS TO EXERCISES, LESSON 4

1. c (para 4-8c(3))
2. b (para 4-5e(5))
3. c (para 4-9e)
4. d (para 4-12a and b)
5. b The Allis forceps is the best choice. Construction of this forceps is such that it will fulfill the needed function without damage to the instrument and without contamination to the sterile field. (para 4-8d(3))
6. b (para 4-12c(2))
7. a (para 4-13c(1))
8. d (para 4-13d)
9. d (para 4-13c(1))
10. b (para 4-14c(2))
11. a (para 4-11c and d, figure 4-4)
12. c (para 4-15b(3))
13. d (para 4-8d(3))
14. To scrape the base of the wound to remove all gelatinous tissue. (para 4-5e(1))
15. rectal speculum (para 4-16c(1))
16. a (para 4-16c(2))
17. c (para 4-16c(3))
18. b (para 4-4b(2))
19. d (para 4-4e(3))
20. a (para 4-5e(4))
21. b (para 4-1b(2))

22. d (para 4-3c(9))

23. b (para 4-3d(1))

24. b (para 4-4a)

25. b (para 4-6b, figure 4-2 B)

End of Lesson 4

LESSON ASSIGNMENT

LESSON 5	Procedures in Orthopedics.
LESSON ASSIGNMENT	Paragraphs 5-1 through 5-40.
LESSON OBJECTIVES	After completion of this lesson, you should be able to:

5-1. Identify the procedures used in reducing fractures of the leg, thigh, hip, knee, ankle, foot, shoulder, arm, forearm, and wrist.

5-2. Identify the procedures used in treating a dislocation of the hip.

5-3. Identify the procedures used in A-K amputation.

5-4. Identify the procedures used in repairing severed tendons in the fingers.

5-5. Identify the types of plaster casts, their uses, and the procedures used in applying the casts.

SUGGESTION After completing the assignment, complete the exercises at the end of this lesson. These exercises will help you to achieve the lesson objectives.

LESSON 5

PROCEDURES IN ORTHOPEDICS

Section I. GENERAL ORTHOPEDIC SURGERY

5-1. INTRODUCTION

Orthopedic surgery is concerned mainly with disorders of the skeletal system, particularly with those parts having to do with locomotion, and usually, not the bones of the anterior chest and the head. Fractures, dislocations, deformities, and other disorders of the skeletal system are included in the area of concern. Orthopedic surgery should hold the interest of the OR specialist for several reasons: The operative areas involved are usually large enough or accessible enough so that the specialist may see the procedure easily. The functional results are often obvious and gratifying even at the time of operation; and the exacting preparation and care of the patient and of the special surgical instruments used challenge the skill of the OR specialist.

5-2. DUTIES OF THE SPECIALIST

Duties of the specialist in the preparation of the patient and the OR are much the same for orthopedic surgery as for other kinds of surgery. However, special problems in orthopedic surgery involved with the preparation of both the patient and the OR require emphasis.

5-3. SPECIAL PROBLEMS IN PREPARATION OF THE PATIENT

a. **Traumatic Conditions**. Patients with acute injuries may present intensified problems of pain, shock, hemorrhage, and respiratory difficulties. In addition, orthopedic patients with open wounds or contusions in or near the proposed operative field present problems in the preoperative skin prep.

b. **Psychological Conditions**. The patient scheduled for orthopedic surgery may be looking forward to his operation as a means of relief from long suffering. On the other hand, he may be quite apprehensive about his postoperative future. He may await surgery with great dread, fearing disfigurement, dependence on others, or necessity for relying on prosthetic devices. Such fears may be all out of proportion to the more likely situation. The specialist must recognize the fact that an attitude of fear and dread, no matter how unrealistic the patient's fear may seem, presents real problems for both the patient and the specialist. The specialist is to do the following when he is prepping the patient:

(1) Be especially alert when the patient seems either anxious or depressed. Watch for any indications of suicidal tendencies.

(2) Be an especially good listener if the patient wants to talk.

(3) Report to the surgeon any extreme behavior that the patient exhibits.

c. **Preparation of the Skin**. The general principles of skin preparation apply to preps for orthopedic surgery. Carry out procedures based on these principles as painstakingly as possible because bacteria left on the skin may get into the incision and produce bone infection. Bone infection is difficult to control and may cripple the patient for life. Therefore, never rely on antibiotics as a substitute for good preparation technique. In addition, exercise great care not to cut or otherwise traumatize the skin while shaving and scrubbing the appropriate skin area. If the patient is to have an enema, wait until this treatment has been completed (if feasible to do so) before starting the prep.

(1) When ordered, perform a regular skin prep procedure such as that described in paragraph 1-10e, preferably 24 hours prior to orthopedic surgery.

(2) Immediately after completing thorough and atraumatic shaving, scrub the prep area with antibacterial detergent for 10 minutes (or such length of time as is prescribed locally), then rinse the area with clear water and dry it. This scrubbing procedure for orthopedic surgery is sometimes referred to as a "sterile" prep. (If the area to be prepped appears particularly grimy or hard to cleanse, soak it in a warm water solution of the antibacterial detergent for 30 minutes prior to this scrub).

d. **Cleansing of Orthopedic Open Wounds**. Regardless of the orthopedic operation that is to be performed, all open orthopedic wounds should be thoroughly cleaned and irrigated either before the surgical prep is done, or as a part of the sterile prep immediately prior to the operation (with the patient anesthetized).

(1) The wound should be cleansed of any dirt or other foreign matter, as their continued presence would tend to result in osteomyelitis postoperatively. Osteomyelitis is an inflammation of the bone and bone marrow caused by bacterial infection and is sometimes very difficult to control. Varying amounts of bony tissue are destroyed. Systemic reactions include fever, pain, swelling, and other evidence of general infection. The chief results are weakness of bone and deformity. The bones most frequently affected are the femur, tibia, and humerus.

(2) The circulator should prepare for the cleansing of such wounds by having ready extra flasks of normal saline, asepto syringes, pans used to catch the waste solution, and hand scrub brushes and orangewood sticks for the removal of imbedded dirt.

(3) Because of the possibility of bone infection, extremely rigid adherence to aseptic techniques is practiced in orthopedics. More than the usual preparation of skin may be done both in the area prepared and in the duration of the scrub.

e. **Prep of Area Covered by a Cast**. Procedures for prepping areas covered by a cast are determined by the individual case, and policies vary among hospitals for these procedures. The cast may be bivalved (split in half lengthwise, in order that it may be removed) or a "window" may be made in the cast. In addition, the patient may be anesthetized for the cast to be removed and the prep to be done (usually done in the OR or the cast room). The surgeon may do these procedures with the specialist assisting. If the specialist does the skin preparation, he must use extra care in order not to nick or otherwise damage the sensitive skin that has been enclosed in the cast. The local policy must be followed.

f. **Immediate Preoperative Prep**. For the immediate preoperative prep for orthopedic surgery, rubber sheeting is placed beneath the part of the patient's body to be prepped so that the sheet under the patient will not become saturated. Otherwise, the procedure is as previously described (see para 1-12c). If the surgery is to be performed upon a limb, the circulator lifts the limb from the table and holds it during the prep.

5-4. SPECIAL PROBLEM IN PREPARATION OF THE OPERATING ROOM

During most orthopedic operations, X-rays are taken at various times during the surgery. The specialist should allow for the extra space needed for the X-ray machine by removing all unnecessary furniture from the room. In addition, extra drapes are needed because the foot of the table is often draped. Moreover, the X-ray cassette must be covered with sterile pillowcases cases before it is placed in the region of surgery. The crowded conditions caused by the presence of the X-ray machine may make the use of sterile back-jackets necessary for the "sterile" members of the operating team.

5-5. OPERATIONS FOR DISCUSSION

a. **General**. For purposes of discussion, each different type of operation listed in b below is described as it is performed on a specific body part. However, the orthopedic operations may be performed upon various bones and joints. As an example, arthrodesis operations (fusion of a joint) may be performed upon joints other than the knee or hip whenever it is desirable to eliminate motion in the joint. When arthrodesis of the spine is performed, the prep, position, drape, and the setup of the OR are modified to meet the needs of the operation to be done.

b. **Specific Operations**. The operations listed below are discussed in paragraphs 5-7 through 5-33.

(1) Closed reduction of femoral shaft fracture with traction.

(2) Basic technique--open reduction of fractures.

(3) Bone-grafting of fractured bone.

(4) Treatment of fractured hips.

(5) Intertrochanteric fracture.

(6) Intramedullary femoral fracture.

(7) Dislocation of the hip.

(8) Arthroplasty of the hip.

(9) Total hip replacement.

(10) Arthrodesis of the hip.

(11) Intramedullary pinning for tibial fracture.

(12) Operation for tibial shaft fracture.

(13) Compression plating of fractures.

(14) Patellectomy.

(15) Reconstruction of the patella.

(16) Arthrodesis of the knee.

(17) Arthrotomy of knee joint.

(18) Treatment of fractures of the ankle and foot.

(19) Excision of exostosis.

(20) Bunionectomy.

(21) Bankart operation.

(22) Treatment of fractures of arm, forearm, and wrist.

(23) Closed suction drainage.

(24) A-K (above knee) amputation of leg.

(25) Tenoplasty of fingers.

5-6. SKELETAL ANATOMY

Refer to Subcourse MD0006 to review the anatomy of the skeletal system.

5-7. REDUCTION (SETTING) OF FRACTURES

This is the correct approximation of the broken portions (fragments) of the bone.

a. **Closed Reduction (External Fixation)**. In closed reduction (external fixation), the fracture is realigned to normal position through external manipulation of the part. Closed reduction is accomplished under x- ray control to be certain that the fracture is in correct position. Closed reduction is the method by which closed fractures are reduced most commonly. Then the alignment is maintained by immobilizing the part by either of two methods.

(1) A plaster cast may be applied to hold the fragments in correct alignment after a fracture has been reduced.

(2) The other method of external fixation is the application of skeletal traction by means of special pins or wire inserted through the soft tissue into bone that is distal to the fracture.

b. **Open Reduction (Internal Fixation)**. This is the reduction of a fracture by the application of mechanical devices (see figure 5-1) (screws, plates and screws, pins, intramedullary nails) through an incision directly to the bone.

5-8. CLOSED REDUCTION WITH TRACTION OF FEMORAL SHAFT FRACTURE

a. **Definition**. This is the reduction of the fracture by the insertion of a sterile pin or wire through the soft tissue and bone distal to the fracture (usually the upper part of the tibia) and the application of skeletal traction.

b. **Indications**. This method of fixation is indicated whenever contraction of the powerful muscles in the area prevents the correct approximation (manually) of the broken fragments.

c. **Special Preparation of the Operating Room**. A sterile tray called a Kirschner wire (K-wire) set may be used. If a set is not to be used, however, the following items should be prepared:

(1) Instruments. A sterile scalpel, needed to make small skin incisions (nicks) at the points of insertion and exit of the wires or pins. Other sterile instruments needed are as follows:

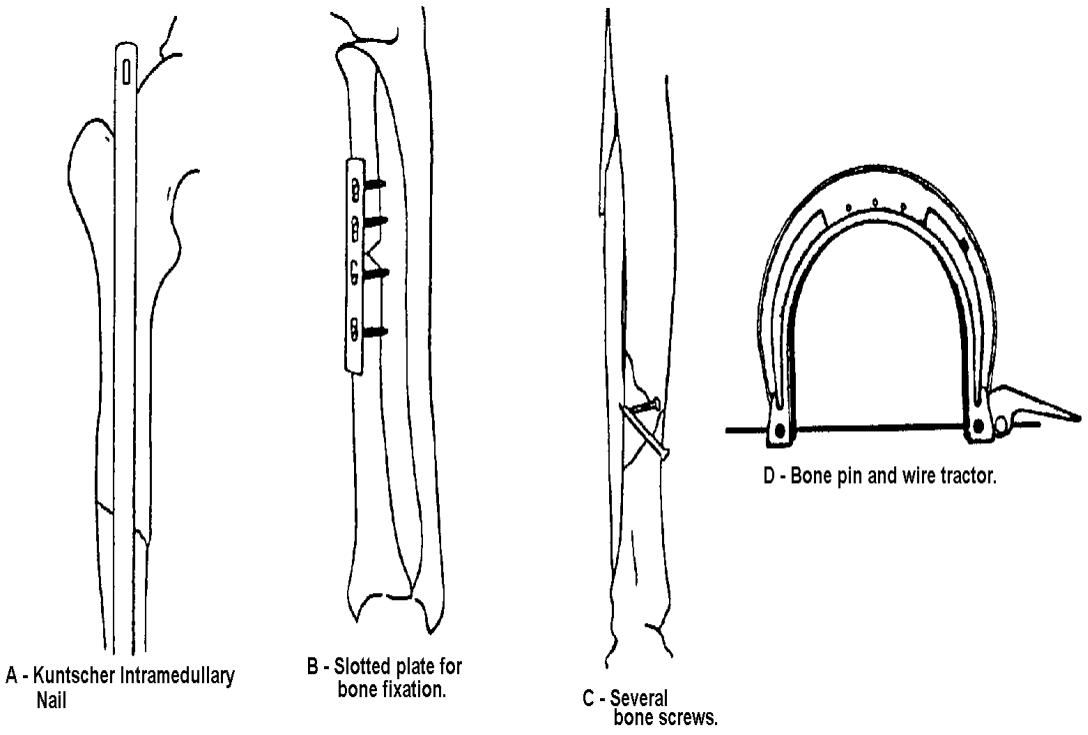


Figure 5-1. Types of internal fixation

(a) A heavy wire cutter, needed to cut off the excess length of wire or pin.

(b) A drill of appropriate size, used to pass the wires or pins through the soft tissue and bone.

(2) Other equipment and supplies needed.

(a) Sterile Steinmann pins or Kirschner wires (K-wires). Because the femur is a large bone surrounded by strong muscles, surgeons usually prefer Steinmann pins for its fixation.

(b) Tractor bows (sterile) of appropriate size for the pins selected. Figure 5-1 D illustrates a tractor bow for use with either Kirschner wires or Steinmann pins.

(c) Sterile cotton or fine mesh gauze for dressing the skin wounds.

(d) Plaster of Paris bandages, as ordered by the surgeon.

(e) Weights sufficient to supply the amount of traction desired by the surgeon.

(f) Corks, to be placed over the ends of the wire.

d. **Preparation of the Patient**.

(1) Anesthesia. The anesthesia of choice is local. The specialist assists.

(2) Position, prep, and drape. The patient is placed in a supine position, with knees over the break of the table. The skin area must be shaved and scrubbed as described in paragraph 5-3c since the insertion of a pin is a sterile procedure. The sterile prep done just prior to surgery is as described above. Draping is as has been described for the draping of an extremity for orthopedic surgery, except that no tourniquet is used for external fixation.

e. **Special Precautions**.

(1) Aseptic technique. The most stringent precaution to be observed during all orthopedic surgery is the maintenance of strict aseptic technique--and it must be maintained by all personnel throughout the procedure. This precaution deserves particular emphasis because any break in technique can produce a serious postoperative bone infection (osteomyelitis).

(2) Other precautions. Other precautions to be observed by the specialist when assisting with either the external fixation or internal fixation of fractures are as follows:

(a) When moving or positioning the patient, the specialist must support the limb both above and below the site of the fracture, correctly maintaining manual traction when traction is necessary. (The maintenance of traction may require the assistance of four or five people.)

(b) The specialist is required to hold the limb in an elevated position while the immediate preoperative prep is done. Since the prep requires 10 minutes or more, the circulator must use good body mechanics when he assumes his stance or he may suffer strain or injury to his back. The circulator can maintain good body mechanics while holding an extremity by supporting his elbows against his body and keeping his back in line directly over his feet. The circulator should stand on a footstool while elevating a patient's foot for the sterile prep. This will place him in a better position for holding and will give the sterile team space enough to drape without contamination.

(c) The scrub waits until the antiseptic solution used to prep the leg is dry before handling any drapes.

(d) The specialist should exercise care to ensure that the sharp working surfaces of the orthopedic instruments are not dulled or made blunt. Dull instruments inflict unnecessary trauma upon the patient.

f. **Handling of Specimen**. No tissue specimen is obtained during this procedure.

g. **Suturing Types Used**. Since the only incision made is a small nick or nicks in the skin, no suturing is done.

h. **Treatment of Other Fractures by Closed Reduction with Traction**.

(1) Indication. In general, closed reduction with traction is done on other bones when a fracture is mechanically unstable, as is seen in certain fractures of the wrist and in oblique fractures of the forearm or the leg. See figure 5-2 for types of fracture lines.

(2) Sites. The most common sites for closed reduction with traction in addition to that described above are the olecranon (elbow), the calcaneus (heel), the lower tibia, tibial tubercle, and the metacarpals. In addition, K-wire fixation without traction is frequently employed for breaks of the phalanges. Such procedures on the phalanges are entered on the OR schedule as "fixation distal interphalangeal (DIP) joint" or "fixation proximal interphalangeal (PIP) joint."

(3) Specialist's role. The specialist's role, in assisting with the treatment of any fracture by closed reduction with traction, is as that described above for a femoral shaft fracture. The adaptations necessary are those having to do with the part of the body being treated and the size of the pins or wires needed.

5-9. BASIC TECHNIQUE--OPEN REDUCTION OF FRACTURES

a. **General**. This procedure is used to repair broken fragments by means of pins, nails, and screws, or with plates and screws, through an open wound. A blind method of fixation may be used by applying a short nail (Smith-Petersen) or a long nail (Kuntscher or Lottes) through the bone without opening the fracture site. Internal fixation is used when a satisfactory closed reduction cannot be obtained or maintained or when soft parts are situated between the fractured fragments. Whenever possible, this operation is done before swelling has occurred or after swelling has subsided. It is not routinely done in the presence of an infection.

b. **Preparation of the Patient**. Routine skin cleansing and draping are carried out according to the site of the operation.

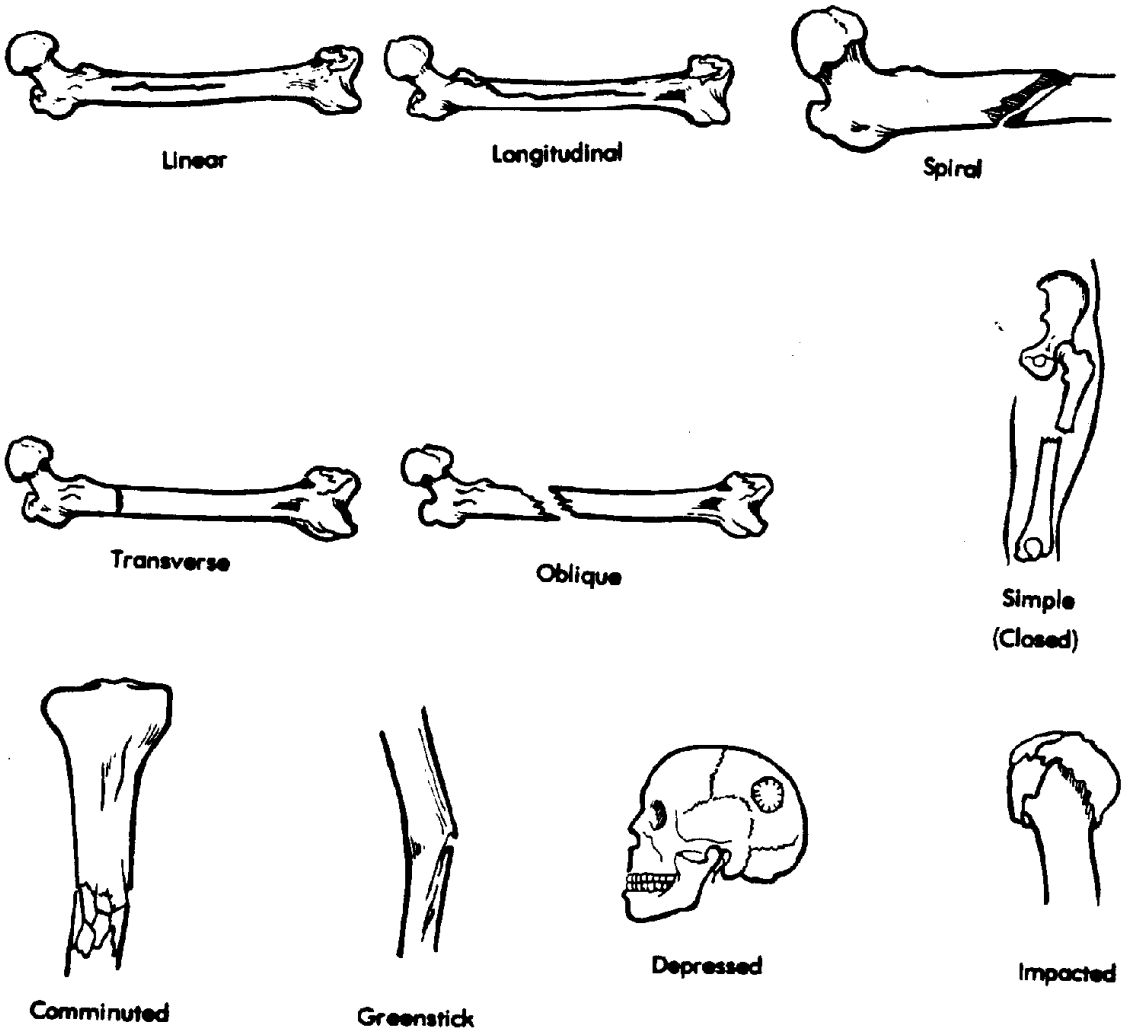


Figure 5-2. Types of fracture lines.

c. **Operative Procedure**.

(1) The stockinette, if used, is cut with bandage scissors to expose the proposed incisional site. The skin and subcutaneous tissue are incised with a scalpel. The skin edges are protected with towels or gauze pads that are secured in place with sutures or metal skin clips. A synthetic surgical skin drape may be used, eliminating the need for towel clips.

(2) The muscles are separated and retracted (with retractors). With a periosteal elevator, the periosteum is divided and elevated. Scar and granulation tissue is removed. Bleeding is controlled with hemostats and fine gut ligatures or cautery. Bone wax may be needed to control bleeding of the bone. The fractured bone ends are grasped and approximated by means of bone-holding forceps or with clamps.

(3) The fractured fragments are fixed by means of the desired plates and screws. The drill bit used should be approximately the same diameter as the body of the screws. This is accomplished with the screw measure and guide. Holes are drilled in the bone in this fashion. An asepto syringe filled with normal saline solution is used to prevent the spread of bone dust and eliminate unnecessary heat from the drilling process. The screws are inserted when the desired holes are obtained.

(4) The periosteum, muscle, and fascia are closed with chromic gut or silk sutures. The skin drape, towels, or pads are removed. The wound edges are protected with clean towels. The subcutaneous tissue is approximated, skin edges are sutured together, and dressings are applied to the wound.

(5) When applicable, the extremity is immobilized in a cast.

5-10. BONE-GRAFTING OF FRACTURED BONE

a. **General**. This procedure involves exposure of the fractured fragments, attachment of healthy bone onto the bone fragments, and insertion of screws through holes made in the graft and into the cortex of the fragments. The amount of grafting material used and the type of graft done generally depends on the location of the non-united bone, the condition of the ends of the fragments, and the preference of the surgeon. The procedure may be used in the following circumstances:

(1) To fill cavities or defects resulting from cysts, tumors, or other causes.

(2) To bridge joints and thereby provide arthrodesis.

(3) To bridge major defects or establish the continuity of a long bone.

(4) To promote union or fill defects in delayed union, malunion, fresh fractures, or osteotomies.

b. **Patient Preparation**. Routine skin cleansing and draping are carried out according to the site of the operation.

c. **Operative Procedure.**

(1) The skin overlying the fractured bone is incised and the scar tissue is excised, as in open reduction. To encourage healing, the sclerosed bone may be drilled or removed to stimulate granulation tissue foundation.

(2) The graft is obtained, and the affected fragments are prepared to suit the graft. To form a bed for an onlay graft, the periosteum and a portion of the outer cortex are removed from the fragmented ends of the bone. To perform an inlay or sliding graft, a special slot is made in the bone fragments for the reception of the graft. Occasionally, a sliding graft is used for tibial fractures. The graft is cut from the proximal fragment of the fractured bone and is slid into the prepared bed over the distal fragment of the bone.

(3) To obtain an inlay graft from the tibia, a curved incision is made along the anteromedial surface of the tibia, with its convexity to the medial side. The periosteum is incised and reflected with an osteotome. The graft is outlined with drill holes, and removed with an electric oscillating bone saw that has a double blade. A fracture of the entire thickness of the donor bone may occur if the osteotomy is not outlined by drill holes.

(4) In an onlay grafting operation, bone-holding forceps are used on the operative site as the drill holes are placed through both the graft and fragments. Screws are then inserted through the holes of the graft and into the cortex of the bone's fragments. In some cases, bone chips are laid over the fragments to be united.

(5) A cancellous graft consists of spongy bone, usually taken from the crest or wing of the ilium. Depending on the position of the patient, the anterior or posterior third of the ilium is used. Exposure of the ilium is relatively easy, but considerable bleeding may occur. An incision is made along the subcutaneous border of the iliac crest. The muscles on the outer table of the ilium are elevated. If chip grafts are required, they are removed with an osteotome parallel to the crest of the ilium. After removal of the crest, the cancellous bone maybe obtained by curetting the cancellous space between the two intact cortices.

(6) The wounds are closed in layers and dressings applied. A plaster casing may be applied to the fractured extremity.

Section II. SURGERY OF THE HIP

5-11. TREATMENT OF FRACTURED HIPS

a. **Definition of Terms**. Fractures of the hip are in reality fractures of the upper end of the femur and are classified under three main groups: (1) the intracapsular types, which include the capital, subcapital, and transcervical fractures; (2) the extracapsular types, which include the intertrochanteric fractures; and (3) the upper femoral epiphyseal separation, usually occurring in young obese boys. The term intracapsular refers to the inside of the hip joint; extracapsular to the outside of the hip joint.

b. **General**.

(1) A subcapital fracture is one that occurs in the upper end of the femur, within the hip joint just beneath the femoral head. Older persons usually are the sufferers because they may fall more often. A subcapital fracture, which may be impacted or grossly displaced, may be caused by indirect violence, such as slipping on a rug or polished floor. The bone gives way, and the patient falls to the floor. After the injury, the leg becomes externally rotated if the fracture is not impacted.

(2) The patient with a displaced subcapital fracture is treated by the insertion of a suitable appliance at the earliest time his general condition permits. If the fracture is close to the femoral head, internal fixation may be supplemented by means of a bone-grafting operation. Delay or nonunion may occur in subcapital fractures, especially in those where the fracture line is unstable. The strong pull of the hip muscles often tends to produce a loss of normal angulation between the shaft and femoral neck, resulting in shortening, external rotation, and adduction deformities. Subcapital fractures are sometimes impacted. These are frequently managed without surgery if they are inherently stable.

(3) A transcervical (intracapsular) fracture occurs in the mid-portion of the femoral neck. These fractures usually require surgery. If possible, internal fixation of the fracture is carried out. Otherwise, a femoral head prosthesis may be used.

(4) An intertrochanteric fracture is located farther from the region of the trochanter and may occur when the person falls directly on the trochanteric region or when his leg is twisted. After the injury, the limb intertrochanteric fractures usually run in different directions, but they generally heal.

(5) Reduction of intertrochanteric fractures may be maintained by plaster hip spica cast, external fixation and traction, or open operation. The latter includes the insertion of a pin or nail into the neck of the femur and the attachment of a plate and screws, such as Jewett nail and plate, a Smith-Petersen nail with a McLaughlin plate, or a Neufeld angled nail and plate, to the other side of the femur.

(6) A separation or slipping of the upper femoral epiphysis (adolescent coxa vara) may occur quickly or gradually. This condition causes a decrease of the angle between the femoral neck and shaft. When this occurs, the femoral head rotates posteriorly and interiorly, and the femoral shaft and neck move forward. This lesion usually is seen either in obese children between the ages of 10 and 16 or following a traumatic injury. Acute displacement or a chronic disability in the hip is usually accompanied by a limp.

(7) An acute displacement of the upper femoral epiphysis is treated by manipulative reduction and introduction of multiple pins across the epiphysis or by manipulative reduction and immobilization with a plaster spica cast. Procedures that are more elaborate are required when a chronic condition exists and is accompanied by gross displacement,

5-12. INTERTROCHANTERIC FRACTURE (SEE FIGURE 5-3)

a. **General.** This is repaired by making an open wound and fixing the fragments with a metal appliance such as a Jewett angled nail, a Smith-Petersen nail with a McLaughlin or Thornton plate, a Neufeld nail, a Blount-Moore blade plate and screws, or a Lorenz screw nail and plate. Frequently, a nail alone is not adequate for holding the parts in alignment. Therefore, a nail-plate combination is needed to give fixation to the shaft of the femur.

b. **Special Preparation of the Operating Room**. Besides a basic orthopedic setup, metal appliances as chosen by the surgeon, screws, and screwdrivers will be needed.

c. **Preparation of the Patient**. The patient is placed in a supine position on the fracture table. The hip region is cleansed, and sometimes the prep is extended to include the entire extremity, the abdomen, and the anterolateral portion of the chest. The patient is draped, using a fenestrated sheet and regular sheets.

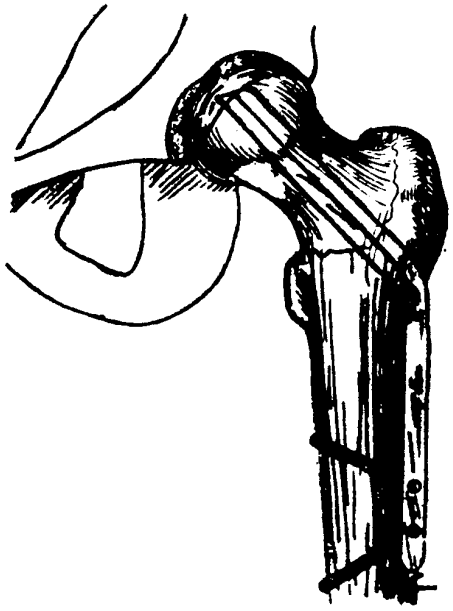


Figure 5-3. Open reduction of intertrochanteric fracture, with Neufeld nail inserted into neck and head and down shaft of femur, using divergent screws. Nail is one-piece stainless steel with V-shaped flanges into neck and head. (From Larson, C.B., and Gould, M.: Orthopedic Nursing, ed. 7, St. Louis, 1970, The C. V. Mosby Co.)

d. **Operative Procedure.**

(1) With a scalpel, a skin incision is made in the thigh, beginning at the level of the superior aspect of the greater trochanter and extending along the shaft of the femur. Bleeding is controlled. Wound edges are protected with skin towels or pads.

(2) The deep fascia is incised and retracted with retractors, and the lateral great muscle is split and retracted to expose the shaft and trochanter of the femur.

(3) With a Kirschner or Smedberg bone drill, a hole is drilled at a point midway between the anterior and posterior cortex of the femur, using at the same time an Asepto syringe filled with normal saline solution.

(4) The desired guide wire is inserted at a 45-degree angle to the shaft and may be changed by starting the insertion of the wire at a lower point on the shaft of the femur. The guide pin is driven up the neck of the femur. This is checked by X-ray films. The guide pin may be removed before, during, or after insertion of the nail appliance.

(5) A desired nail appliance of the appropriate size is driven into the bone so that its plate will be flush with the shaft. The plate attachment is fixed to the shaft with appropriate size screws. X-ray films are taken before closure to determine the proper location and fixation of the nail.

(6) If the fracture is subcapital or intracervical, multiple Knowles pins or a Smith-Petersen nail may be used. The exposure need not be as extensive as for the nail and plate combination since no side plate is attached to the femoral shaft. If multiple pins are used, they are placed in much the same manner as a guide pin. Usually, four are inserted parallel to each other in a boxlike pattern.

(7) If the fracture is subcapital or intracervical, the surgeon may decide to use a primary prosthesis rather than attempt fixation of the fracture.

(8) The wound is closed in layers. Skin towels or pads are removed; dressings are applied, and in some cases, plaster of Paris is applied.

5-13. INTRAMEDULLARY FEMORAL FRACTURE

a. **General**. The surgery for the repair of an intramedullary femoral fracture involves insertion of a nail through the intramedullary canal of the proximal and distal fragments of the femur, usually through a posterolateral incision. Most fractures of the femoral shaft are caused by direct violence, which results in short, oblique, or transverse fractures; few result from indirect violence, which produces a torsion force. The latter situation usually causes a spiral fracture. Others are considered pathological fractures due to the presence of metastatic carcinoma, Paget's disease of the bone, and dysplasia. Patients with a fractured femur suffer severe pain and shock not only due to the injury itself, but because of associated injuries.

b. **Special Preparation of the Operating Room**. Besides a basic orthopedic setup, plates with screws and intramedullary nails such as the Kuntscher, cloverleaf-shaped, or Hansen-Street diamond-shaped nail will be needed according to the directions of the surgeon.

c. **Patient Preparation**. In addition to regular prep, position the patient on his side. Proper supports to stabilize the patient will be needed along with X-ray equipment

d. **Operative Procedure**.

(1) Through a posterolateral incision made with a scalpel, the fracture site is exposed and retracted, and wound edges are protected. Bleeding vessels are clamped and ligated or cauterized.

(2) A nail is selected and tested to fit the distal portion of the fractured bones according to their width and size and then the proximal fractured fragments. The fragments are reamed with a reamer that is the same size as the nail.

(3) The proximal fragment usually is reamed out up through the isthmus. This is the narrowest portion of the intramedullary canal, where the nail might get caught during its insertion.

(4) A guide wire is driven in retrograde fashion up through the proximal fragment and out through the greater trochanter until the guide wire emerges through the skin at the level of the posterior lateral buttocks. Before this step is carried out, the thigh must be abducted and flexed so that the guide pin will not be driven up into the chest or abdomen.

(5) A skin incision is made around the guide pin; then a reamer is inserted over the guide wire. A hole is reamed into the top of the femur at the greater trochanter; then the nail is driven down over the guide wire until it emerges at the fracture site. The guide wire should be withdrawn as soon as the nail is firmly seated in the proximal fragment. Otherwise, the nail may bind on the guide pin.

(6) The fracture is reduced and aligned correctly in regard to rotation. The nail is then driven into the distal fragment (see figure 5-4) and its position is checked with X-ray films.

(7) The wound is closed and dressings are applied. The affected leg usually is placed in balanced suspension, and, on occasion, traction is applied. On the other hand, the leg may merely be placed on a pillow.

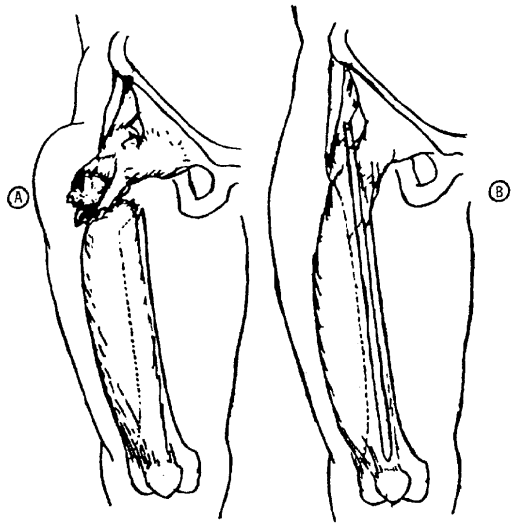


Figure 5-4. A-Fracture of upper end of shaft of femur. Displacement fracture at subtrochanteric site with interposition of torn vastus muscle. This is most common type of fracture in upper end of shaft causing nonunion B-Treatment by Kuntscher rod. (From Miller, D.S.: Surg. Clin. North Am. 45:38, 1965.)

5-14. DISLOCATION OF THE HIP

a. **General**. Although dislocation of the hip does not commonly occur, it may be caused by a severe blow that displaces the head of the femur out of the acetabulum. In some injuries, the head of the femur is pushed centrally, carrying with it the floor of the acetabulum. In such conditions, the lower extremity on the affected side appears to be shortened, and occasionally the rim of the acetabulum or head of the femur may be fractured.

b. **Pathological Dislocation**. A pathological dislocation of the hip may be caused by (1) a severe infectious disease such as scarlet fever, typhoid fever, or tuberculosis; (2) infantile paralysis; or (3) a chronic arthritis resulting in destruction of the femoral head or the acetabulum.

c. **Congenital Dislocation**. The term congenital dislocation includes various degrees of displacement of the femoral head from its normal position, as well as subluxations. In some advanced cases, a shelf reconstruction operation is done; however, open reduction sometimes is necessary in the early stages of the disease.

d. **Mode of Treatment**. The choice of operation depends on the degree of injury and the condition of the patient. The types of operations that may be done to treat a dislocation of the hips include (1) closed reduction with immobilization by plaster spica cast, (2) open reduction with screw fixation for reducible fragments, (3) arthrodesis, or (4) arthroplasty.

5-15. ARTHROPLASTY OF THE HIP

a. **General**. In this operation, the diseased joint is severed, the hip dislocated, and the articulating surfaces remodeled with the aid of a metallic cup or a prosthetic replacement. This is frequently done when the joint is damaged by a degenerative disease such as arthritis or by a pyogenic infection. Sometimes the femur is simply covered; but in other cases, it is replaced by a plastic or metal prosthesis.

b. **Preparation of the Operating Room**. A basic orthopedic setup is needed plus appropriate appliances, as well as special retractors, rasps chisels, osteotomes, gouges, extractors, and reamers.

c. **Preparation of the Patient**. The patient is positioned on the operating table in a supine or lateral position, the operative skin area is cleansed, and the patient is draped.

d. **Operative Procedure: Mold Arthroplasty**.

(1) The skin is incised with a scalpel, and the bleeding vessels are controlled by cautery or ligatures.

(2) The necessary muscles are divided or moved with their attachments to expose the hip joint.

(3) The capsule of the hip is incised or excised as necessary.

(4) The hip is dislocated to expose the head of the femur and the acetabulum.

(5) These are shaped and reamed to accept the mold or cup of choice.

(6) The hip is reduced, and the position is checked.

(7) The wound is closed in layers, reattaching or transplanting as needed all muscles that were interrupted. Dressings are applied.

(8) Postoperatively, abduction and neutral alignment must be maintained until the patient is capable of controlling this himself.

e. **Operative Procedure: Prosthetic Arthroplasty**.

(1) The skin is incised with a scalpel, and the bleeding vessels are controlled by cautery of ligatures.

(2) The necessary muscles are divided or moved with their attachments to expose the hip joint.

(3) The capsule of the hip is incised or excised as necessary.

(4) The hip is dislocated to expose the head of the femur and the acetabulum.

(5) The acetabulum is examined and reamed if needed.

(6) The neck of the femur is osteotomized and the medullary canal reamed at the proper angle to accept the appliance of choice.

(7) The prosthesis is seated in the femoral canal and the hip reduced.

(8) The wound is closed in layers, reattaching or transplanting as needed all muscles that were interrupted. Dressings are applied.

(9) Postoperatively, abduction and neutral alignment must be maintained until the patient is capable of controlling this himself.

5-16. TOTAL HIP REPLACEMENT

a. **Room and Patient Preparation**. Preparation of the room and patient are the same as for paragraph 5-15 above.

b. **Operative Process**.

(1) The skin is incised with a scalpel, and the bleeding vessels are controlled by cautery or ligatures.

(2) The necessary muscles are divided or moved with their attachments to expose the hip joint.

(3) The capsule of the hip is incised or excised as necessary.

(4) The hip is dislocated to expose the head of the femur and the acetabulum.

(5) The acetabulum is shaped and reamed to accept the acetabular portion of the appliance. The proper angle of this component is very important.

(6) The acetabular component is placed and stabilized, either by the use of methyl methacrylate or by employing the proper guides and positioners for the appliance.

(7) The neck of the femur is osteotomized, and the medullary canal is reamed at the proper angle for the chosen prosthesis.

(8) The femoral component is seated and stabilized as required.

(9) The hip is reduced, and the position is checked.

(10) The wound is closed in layers, reattaching or transplanting as needed all muscles that were interrupted. Dressings are applied.

(11) Postoperatively, abduction and neutral alignment must be maintained until the patient is capable of controlling this himself.

5-17. ARTHRODESIS OF THE HIP

a. **General**. This operation involves fusing together the articular surfaces of the hip joint by means of osteotomy, insertion of a bone graft taken from the ilium or femur, and internal fixation with a hip nail and screws. This may be done to treat tuberculosis of the hip or relieve pain and dysfunction due to trauma or other lesions such as tumor. Some hip deformities and those produced by muscle imbalance or instability may be treated by arthrodesis.

b. **Preparation of Operating Room**. This is the same as described for arthroplasty (see para 5-15b) plus a bone-grafting setup.

c. **Preparation of the Patient.** Although, the patient may be positioned on the table in a lateral position, prone or supine will often be used when a graft is to be taken from the femur.

d. **Operative Procedure**. This is similar to arthroplasty of the hip, as described in paragraph 5-15.

Section III. OPERATIONS ON THE TIBIA

5-18. INTRAMEDULLARY PINNING FOR TIBIAL FRACTURE

a. **General**. This procedure involves the insertion of a nail through a short incision made over the anterior aspect of the tibia and medial to the tibial tubercle. Proper alignment and apposition are quite important to the success of this operation, as well as an accurate fit in the medullary canal. This method obviates the need for plates.

b. **Operating Room Preparation**. A basic orthopedic setup will be needed, plus nails and other instruments as requested by the surgeon.

c. **Patient Preparation**. The patient is placed in the supine position, and either the leg is placed in traction to the foot or the table is bent so that the leg hangs freely, using gravity for traction.

d. **Operative Procedure**.

(1) The fractured fragments are exposed in a manner similar to the procedure described for intramedullary nailing of a femoral fracture. The fracture is reduced.

(2) A 3/8-inch drill hole is made through the outer cortex at the bend of the mid-portion of the tibial tubercle. The nail is inserted in the drill hole with its flange facing outward. It is driven down the fracture site and its position determined. X-ray films are taken.

(3) The wound is closed with chromic gut and silk sutures. The affected extremity is encased in a cast.

5-19. OPERATION FOR TIBIAL SHAFT FRACTURE

a. **General**. For simple transverse fractures and many oblique fractures, the fragments are reduced by external manipulation and the leg encased in a plaster cast. For severely fragmented fractures, skeletal traction or the insertion of an appropriate appliance may be used. Usually, these fractures are at the lower and middle thirds of the tibial shaft and at the junction of these two thirds. The fractures that result from a direct blow often are the transverse or comminuted types, whereas those that result from a twisting force are the spiral type.

b. **OR Preparation**. Skeletal traction or plaster cast setup will be needed. If prescribed, the internal reduction setup with plates and screws of desired type and size, screws alone, transfixing wires, or an intramedullary nail will be used. In nonunion cases, a bone-grafting setup is also needed.

c. **Patient Preparation**. This is the same as in paragraph 5-3f.

d. **Operative Procedures**. This is the same as in paragraph 5-9c.

5-20. COMPRESSION PLATING OF FRACTURES (SEE FIGURE 5-5)

a. **General**. The use of compression in achieving fixation and promoting union in cancellous bone is now well accepted. This plate relies on the mechanical compression prior to fixation for its function. It provides rigid fixation not only because of the compression, but also because it is a very thick, heavy plate. The advantages of compression are the fixation is more rigid, the gap between the fragments that must be bridged by new bone is narrowed, and the external immobilization required after surgery is reduced or may even be eliminated.

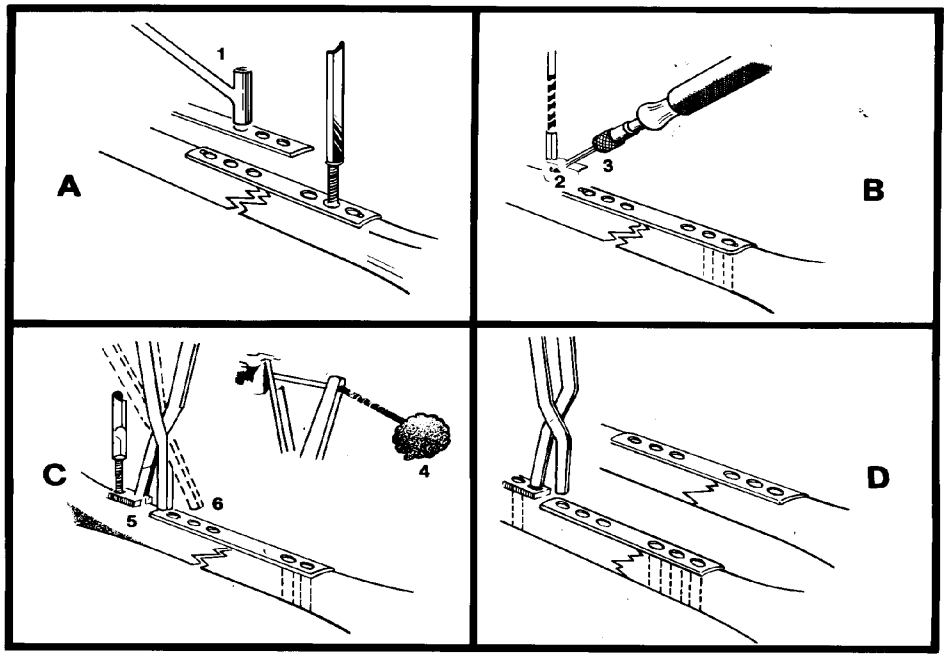


Figure 5-5. Compression plating of fractures. (From Orthopaedic Instruments and Procedures, Warsaw, Ind., 1970, Zimmer of Canada, Ltd., The Fred Schad Co., Inc., Columbus, Ohio.)

b. **Operating Room Preparation.** The basic orthopedic instrument setup is needed, with the addition of the compression plating set. Several instrument companies manufacture various types of compression instruments and implant systems. The purpose of such a system is to approximate the bone fragments under compression during the act of applying an appliance for rigid fixation.

c. **Patient Preparation.** Positioning and preparation of the patient depends on the fracture site.

d. **Operating Procedure**. After the fracture has been reduced, the proper plate and screws are selected. The periosteum is stripped in preparation for plating.

(1) To attach one end of the plate to the bone, the plate is centered over the fracture. Holes are drilled in proximal fragment using a hand-held drill guide. After the hole is drilled, a self-tapping screw is placed. (If the surgeon prefers, a separate tapping instrument is included in the set.)

(2) The plate is affixed to the proximal end with necessary screws. A locator drill guide hook is placed in the elongated slot on the distal end of the plate and an anchor hole is drilled. A Trinkle handle is provided which can be snapped to the locator drill guide.

(3) With compression clamp capstan handle in free position, the compression clamp foot is placed over the anchor hole. The anchor screw is inserted. The handles are pivoted toward the anchor screw and the compression clamp hook is engaged into the slot on the distal end of the plate. Capstan handles are locked across the compression clamp. Compression is applied by turning the capstan handle knob clockwise.

(4) All remaining bone screws are then placed with full compression applied. Compression is then released by swinging the capstan handle to a free position. The anchor screw and compression clamp are removed.

(5) The wound is closed in the routine manner. The affected limb may or may not be placed in a plaster cast.

Section IV. OPERATIONS OF THE KNEE

5-21. PATELLECTOMY

a. **General.** This operation involves the excision of the bone portion of the patella (kneecap) and repair of the quadriceps expansions. Fractures of the patella are of the transverse, comminuted (stellate) or linear type. They are usually caused by direct contusion or muscular stress. The fragments of bone, especially in a transverse fracture, may separate when the torn quadriceps muscle pulls them apart. If this occurs, the quadriceps mechanism must be repaired. Linear or comminuted fractures in which the fragments do not separate are immobilized in a cast. If one pole of the patella is avulsed, it may be excised and the quadriceps repaired. A patellectomy is done to aid knee function if the patella is diseased or too severely injured to be repaired.

b. **Operating Room Preparation.** The setup is the basic orthopedic setup, including Cave knee retractors and Kocher retractor, bone awl, and rongeurs.

c. **Patient Preparation.** The patient is placed on the operating table in a supine position, with the affected knee joint at a level with the break of the lower section of the table. The foot section of the table is lowered, or the knee is flexed by placing a suitable sandbag beneath its posterior aspect. The extremity is cleansed, and the patient is draped with sheets, as for draping a lower extremity.

d. **Operative Procedure.**

(1) A curved, transverse, or paramedian incision is made over the knee, and the capsular tendon ligament of the joint and the quadriceps are exposed.

(2) The patellar ligament is incised to expose the anterior surface of the patella.

(3) The fragments of the patella are removed from the surrounding tendon by sharp dissection.

(4) In some cases, the quadriceps and patella tendon are sutured with chromic gut or fine stainless steel wire.

(5) The defect in the patellar ligament is closed with sutures. The wound is closed and the extremity immobilized in a cast.

5-22. RECONSTRUCTION OF THE PATELLA

a. **General.** This operation involves the fixation of the patella tendon and its bony attachments to the tibia or application of the soft tissues on the medial side of the patella tendon. Its performance is prompted by recurrent dislocation of the patella tendon, which may originate from a blow against the inner side when the knee is flexed. More often, it is a congenial develop-mental phenomenon associated with a shallow groove in the femoral condyles, a ball-shaped patella, or knock-knee.

b. **Operating Room Preparation.** The basic orthopedic setup is needed, including a textile pack for the lower extremity, plus instruments for internal fixation of fractures or patellectomy (see para 5-21b).

c. **Patient Preparation.** The patient is prepared as described for patellectomy (see para 5-21c)

d. **Operative Procedure.** One of several operations may be done, depending on the condition. The most common operations are (1) transfer of the patella tendon and its bony attachments inward on the tibia, similar to arthroplasty, (2) wedge osteotomy of the lateral femoral condyle, similar to arthrodesis, or (3) tendon or fascia lata fixation of the patella to the inner condyle of the femur, similar to patellectomy.

5-23. ARTHROPLASTY OF THE KNEE JOINT

a. **General.** In this operation, the tibial articular surfaces are replaced by a metallic prosthesis that articulates with the femur. It is done in case of severe arthritic changes in the knee when the joint appears salvageable. Otherwise, arthrodesis is done.

b. **Operating Room Preparation.** This is the same as that described for basic orthopedic setup and patellectomy, including bone curettes, osteotomes, chisels, raspatories, and rongeurs.

c. **Patient Preparation**. The patient is placed on the operating table in a supine position, with the knees at the level of the lower break section of the table. The knee maybe flexed by breaking the table. The posterior portion of the knee should be supported by a pad, and the leg should rest on the table pad.

d. **Operative Procedure.**

(1) With a scalpel, a long skin incision is usually made down through the quadriceps tendon, which is dissected free from the femur by means of curved scissors, tendon strippers, and an elevator. Bleeding is controlled with hemostats and fine sutures. Skin towels are applied and secured to the wound edges if a synthetic skin drape has not been used. The patella is separated from the femur, using a tenotomy knife and bone hooks.

(2) The patella is elevated and inspected. Sometimes it is removed by means of bone elevators, gouges, and rongeurs. The bony surfaces are smoothed.

(3) A prosthesis (McKeever or Sbarbaro) is inserted for restoration of the anatomical contour and for elimination of friction with the opposed cartilage. The prosthesis is anatomically contoured and fits into the upper end of the tibia. It is designed to reestablish the anatomical outline of the articular surface. A flat surface on the tibial condyle is first created with a saw or osteotome, and the prosthesis is inserted.

(4) The wound is closed in layers. Surgical dressings are applied to the wound and secured with bandages. The leg is immobilized in a plaster splint.

5-24. ARTHRODESIS OF THE KNEE

a. **General.** This procedure involves osteotomy and fusion (thus immobilization) of the joint with insertion of metal screws or a nail. Compression arthrodesis by means of transfixion by pins inserted through the femur and tibia and incorporated in turnbuckle clamps may be used.

b. **OR Preparation**. This is as described for arthroplasty of the knee, with suitable appliances such as Charnley clamps, knee plates and screws, or intramedullary rods.

c. **Patient Preparation**. This is the same as for arthroplasty of the knee (see para 5-23c).

d. **Operative Procedure**. Similar to that described for arthroplasty of the knee joint (see para 5-23d).

5-25. ARTHROTOMY OF KNEE JOINT FOR EXCISION OF TORN CARTILAGE (SEE FIGURE 5-6)

a. **General.** In this operation, the knee joint is exposed and explored through an anteromedian, paramedian, or oblique incision, and the torn meniscus (cartilage) is removed. This operation is needed because of an injury caused by a twisting motion which ruptures the internal and external semilunar cartilages. This injury may cause the anterior or posterior horn to become detached from the upper tibia. Or the cartilage may split, allowing one portion to enter the central region of the knee joint and the other portion to remain in its normal position along the outer margin of the joint.

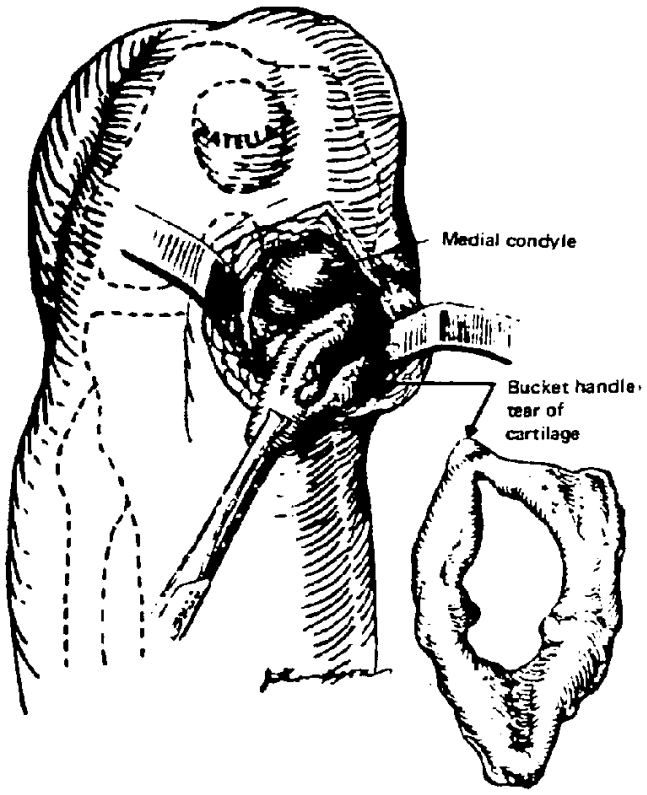


Figure 5-6. Bucket-handle tear of internal semilunar cartilage. (From Richards, V. Surgery for General Practice, St. Louis, 1956, The C. V. Mosby Co.)

b. **Operating Room Preparation.** Setup is as described for patellectomy (see para 5-21b), including a cartilage osteotome and tenotomy knives.

c. **Patient Preparation**. This is the same as for patellectomy (see para 5-21c).

d. **Operating Procedure**.

(1) An incision is made in the knee joint and carried through the subcutaneous tissue; wound edges are protected, as described for internal fixation.

(2) The capsule of the knee is opened, and its edges are retracted; the synovial membrane is opened.

(3) The medial and lateral menisci are identified, and the structures of the knee joint are examined, using elevators and retractors. Broken cartilage and loose body or synovial tabs are removed, using Ochsner forceps, a long knife, tenotomes, meniscectomy knives, and tissue forceps. The knee joint is irrigated, using an asepto syringe filled with normal saline solution.

(4) The synovial layer is closed with plain gut number3-0 swaged to 1/2-circle, trocar point Murphy needles.

(5) The wound is closed in layers and covered with dressings. The extremity is sometimes stabilized in a splint or cylinder cast.

Section V. OPERATIONS ONTHE ANKLE AND FOOT

5-26. TREATMENT OF FRACTURES

a. **General.** These procedures involve the reduction of fractures and immobilization of fragments by external fixation or by open reduction with fixation sutures, bolts, or screws.

b. **Operating Room Preparation.** The instrument setup is similar to that for a patellectomy (see para 5-21b), using smaller-
sized items to suit anatomical structures.

c. **Patient Preparation.** Draping of extremities is discussed in paragraph 1-27.

d. **Operative Procedure.** This depends on the exact location and extent of the damage.

(1) A fracture displacement of either the lateral or medial malleolus may involve a rupture of a main supporting ligament on the opposite side of the ankle from that sustaining the damaging blow. This ligament rupture would usually require surgery to avoid interposition and malreduction.

(2) A posterior chip fracture of the tip of the tibia, which involves more than one of the articular surfaces, is treated by internal fixation if it cannot be reduced by a closed reduction operation.

(3) A rupture of the lower tibiofibular ligament, situated just above the ankle joint, usually is repaired by means of a transfixion bolt or screws.

(4) In falls from a height, the oscalcis may become fractured, and the attachment of the Achilles tendon may be avulsed (torn away) by muscular contraction. The avulsion of the Achilles tendon at its insertion or the displaced fracture of the tuberosity may be treated by open reduction and insertion of sutures. If there is marked involvement of the subtalar joint, arthrodesis may be done several weeks after the original injury.

(5) Fractures and separation of the internal malleolus are usually treated by open reduction and fixation with screws or sutures.

5-27. EXCISION OF EXOSTOSIS

a. **General.** This procedure involves the removal of the bony protuberances about the tendon or muscle insertions on a bone. It is done to restore function of a joint.

b. **OR Preparation.** The setup includes a basic patellectomy set, with fine chisels and osteotomes, curettes, and rongeurs.

c. **Patient Preparation.** The position and draping of the patient will depend on the operative site.

d. **Operative Procedure.**

(1) An incision is made over the prominence of the exostosis, using a scalpel, scissors, and tissue forceps.

(2) The exostosis is dissected free and cut off at its base where it connects with the cortex of the normal bone, using heavy scissors, tenaculum, Ochsner forceps, chisels, elevator, osteotome, and mallet. The remaining bony surfaces are made smooth with a rongeur and file.

(3) The facial layer is closed with interrupted silk or chromic gut sutures numbers 3-0 and 2-0, and the skin edges are approximated with fine wire, nylon, or silk. Surgical dressings are applied to the wound and secured by applying a gauze bandage.

5-28. BUNIONECTOMY (SEE FIGURE 5-7)

a. **General.** The Mayo operation includes a partial excision of the head of the first metatarsal. The Keller operation includes a resection of the proximal part of the first phalanx of the great toe. The McBride operation includes the attachment of the adductor muscles of the great toe to the shaft of the first metatarsal. The Silver operation includes the excision of the exostosis, formation of a capsular flap, and insertion of sutures in the distal flap to adduct the great toe.

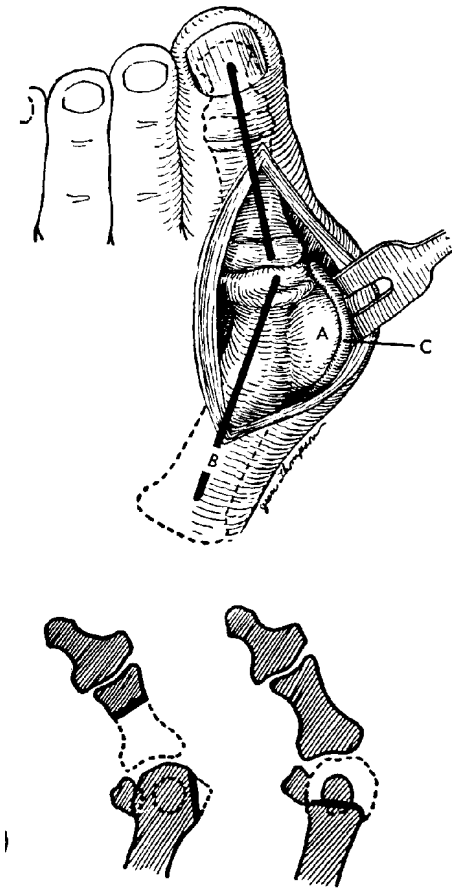


Figure 5-7. Bunionectomy. 1, Bunion: **A-**exostosis of metatarsal head; **B**-hallux valgus deformity; C, overlying bursa. 2, Operations for hallux valgus. (From Richards, V.: Surgery for General Practice, St. Louis, 1956, The C.V. Mosby Co.)

b. **Operating Room Preparation.** The instrument setup is as for arthroplasty of a small joint and is similar to that for excision of exostosis. Refer to paragraph 5-27b.

c. **Patient Preparation.** The entire lower leg and foot are prepped, and drapes placed in such a way as to support the foot as well as cover the parts not exposed for the procedure.

d. **Operative Procedure.** A curved dorsal incision is made over the metatarsophalangeal joint on its medial side, and the bursa and exostosis are removed, as described in paragraph 5-27d. The wound is sutured with fine sutures, dressings are applied, and the foot is usually immobilized in a plaster boot.

Section VI. OPERATIONS ON THE SHOULDER, ARM, FOREARM, AND WRIST

5-29. BANKART OPERATION (SEE FIGURE 5-8 [A through H])

a. **General.** This operation is for repairing a defect of the glenoid cavity through a deltopectoral incision. In some cases, this is augmented by the Putti-Platt repair, which is the bringing together of the capsule and the subscapular muscle. The operation is indicated to treat recurring dislocation of the shoulder joint. Other operations used to treat the same symptom are Magnuson, DePalma, Neer, and Nicola operations.

b. **Operating Room Preparation.** The basic orthopedic setup will be needed and also an internal fixation set, including narrow curved osteotomes, chisels, bone drill and fine drill points, and a prosthesis or staples, if desired. The Neer operation requires a special shoulder prosthesis, which replaces the proximal humeral articulation. If bones are shattered, staples or wires may be needed for fixation of fragments.

c. **Patient Preparation.** The patient is placed on the operating table in a supine position, with his affected side turned at a 45-degree angle toward the other side and supported by sandbags and padded braces. The table is tilted to provide a longitudinal operative site. Routine skin preparation and shoulder draping procedures are done.

d. **Operative Procedure.**

(1) A curved skin incision is made over the anterior aspect of the shoulder so that the distal end of the incision is over the deltopectoral groove.

(2) The exposure is made between the deltoid and the greater pectoral muscles. The cephalic vein is ligated and retracted.

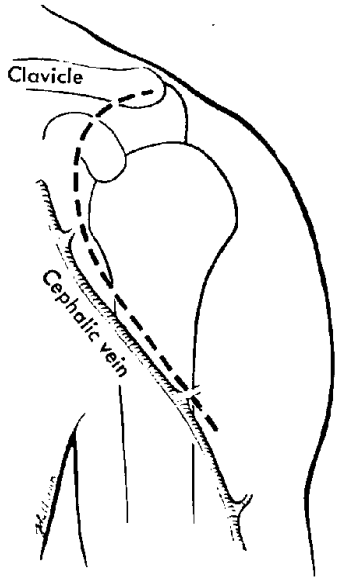
(3) The coracoid process is divided by an osteotome and then pulled downward.

(4) The tendon of the subscapular muscle is exposed, clamped, and divided.

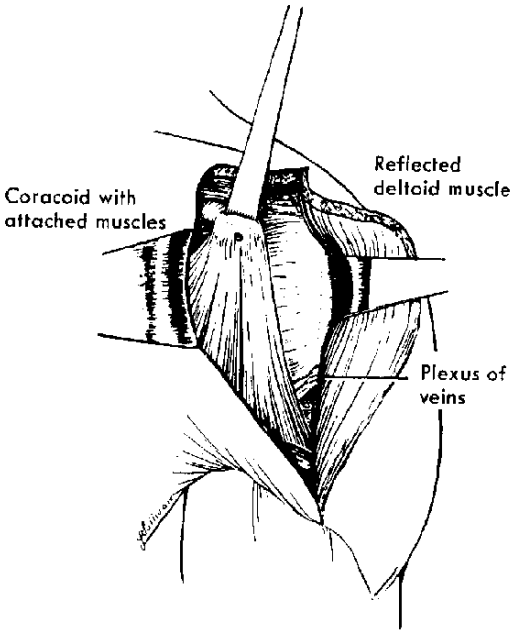
(5) The joint capsule and the glenoid ligament are reattached to the exposed bone either by means of sutures, which are inserted in drill holes with staples, or by means of pullout wire sutures, as described for tendon repair. The redundant capsule is attached to the stabilized glenoid ligament and to the periosteum on the neck of the scapula.

(6) The subcapular muscle is reattached to the lesser tuberosity, and the coracoid process is reattached. The muscle, subcutaneous tissue, and skin are closed in layers.

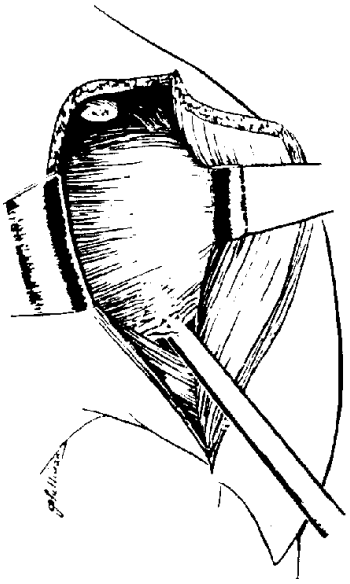
(7) Dressings are applied to the wound. The shoulder is supported by applying a Velpeau bandage with the arm positioned close to the chest and the elbow flexed at about a 40-degree angle.



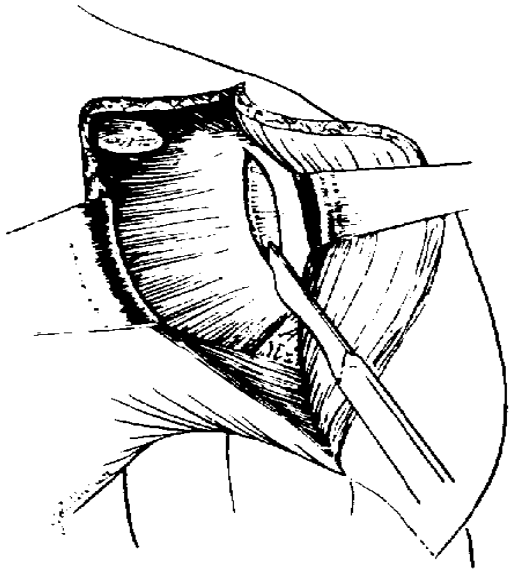
A--Skin incision.



B--Coracoid is being divided.

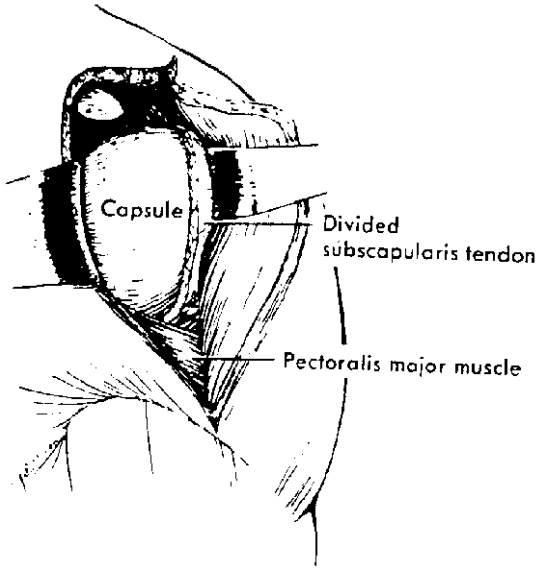


C--Inferior margin of subscapular tendon is being identified.

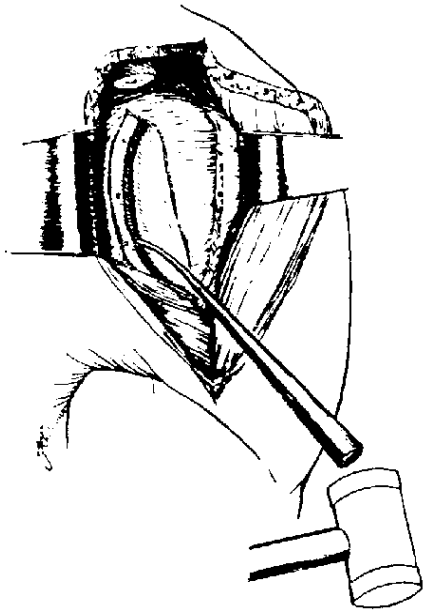


D--Subscapular tendon is being divided near lesser tuberosity.

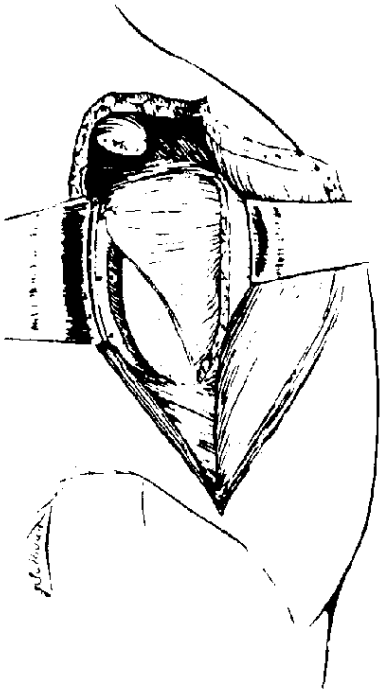
Figure 5-8. Bankart operation (technique of Cave and Rowe) (continued). (From Crenshaw, A.H., editor: Compbell's Operative Orthopaedics, ed. 5, St. Louis, 1971, C. V. Mosby Co.)



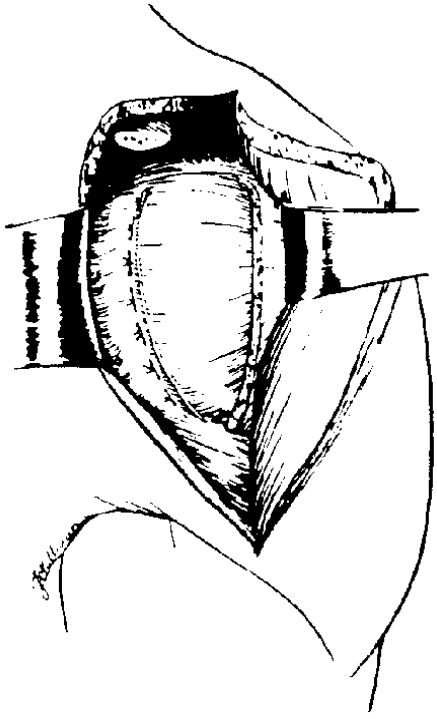
E--Subscapular tendon has been retracted medially.



F--Holes are being made through rim of glenoid.



G--Free lateral margin of capsule is being sutured to the rim of the glenoid.



H--Medical margin of capsule had been lapped over lateral part and sutured in place.

Figure 5-8. Bankart operation (technique of Cave and Rowe) (concluded).

5-30. TREATMENT OF FRACTURES OF THE ARM, FOREARM, AND WRIST

a. **General.** Treatment of fractures involves the reduction of the fragments of bones by means of external or internal fixation.

(1) In fractures of the humerus, there is often overriding. Injury to the radial nerve is not common. In supracondylar fractures of the humerus, the distal fragments may be displaced, resulting in tension of the nerves, tendons, and vessels. If supracondylar fractures and dislocations of the humerus cannot be reduced, they are treated by internal fixation using wires or plates and screws, or they may be treated by overhead external skeletal traction applied through the olecranon.

(2) Fractures of the olecranon process are commonly treated by open reduction with insertion of wire sutures, Rush nails, or long malleable screws.

(3) Fractures of the forearm bones in children are usually treated by closed manipulation and casting. In adults, however, these fractures usually require open reduction and internal fixation in order to restore anatomical alignment. Plates, intramedullary nails, or compression devices may be used. Occasionally, bone grafts are applied at the time of surgery.

(4) Fractures of the wrist bones generally are treated by closed manipulation and casting, although some nonunions of the scaphoid may require bone grafting.

(5) Fractures of the bones of the hand may require open reduction and pin fixation, although most can be treated with traction or closed manipulation and casting.

b. **Operating Room Preparation.** The setup includes a basic orthopedic set, plus intramedullary nailing or plating instruments as requested.

c. **Patient Preparation.** The patient is placed in a supine position and the affected extremity supported. Routine skin cleansing and draping are carried out.

d. **Operative Procedure.** This is the same as in paragraph 5-9c.

5-31. CLOSED SUCTION DRAINAGE OF THE ARM, FOREARM, AND WRIST

a. **General.**

(1) The use of suction drainage has become routine for most procedures involving the medullary bone in which complete hemostasis cannot be obtained by the usual methods. It is important to prevent the formation of hematomas since there appears to be a connection between these and wound infections.

(2) The removal of blood and fluid in arthrodesis results in reduction of excess swelling and closer apposition of bone chips, and should facilitate revascularization. There is the possibility that by removing blood, less granulation and scar tissue is formed. This could result in better motion, particularly in arthroplastic surgery.

b. **Operative Procedure.**

(1) A malleable needle comes with the closed-suction system. It is threaded onto small drainage tubes. By using the needle to make stab wounds, the tubes are brought out beyond the area of the incision.

(2) These tubes are connected to a larger tubing that is part of the set.

(3) The larger tubing is connected to an evacuator. This unit exerts constant negative pressure and has clear, marked walls to permit determination of the quality and quantity of drainage.

(4) The evacuator may be emptied without disturbance of the system.

(5) A retaining suture of silk number 2-0 may be passed through the skin and tied around each of the drainage tubes. This minimizes the possibility of their accidental removal.

Section VII. PLASTIC AND AMPUTATION PROCEDURES

5-32. A-K AMPUTATION OF LEG

a. **Definition.** A-K amputation is the removal of a leg above the knee (B-K means below the knee). The amputation may be either closed or open. Closed amputations are those in which the stump is sutured at the time of surgery, while open ones are left to drain and are closed by a subsequent procedure. Above-knee amputations are performed through the shaft of the femur. The ideal length of stump is 10 or 11 inches measuring from the tip of the trochanter.

b. **Indications.** This procedure is necessitated by one of three causes. The most frequently encountered cause is traumatic injury to the extent that the limb is not expected to survive. Another cause is gangrene--death of the tissues caused by a lack of oxygen and nutrients resulting from hampered circulation of blood to the affected part, seen in certain disease processes. The final condition necessitating amputation is the presence of malignant neoplasms or cancerous tumors of the bone or soft tissues of the limb.

c. **Special Preparation of the Operating Room**.

(1) Instruments. These comprise the routine setup for the amputation of a limb, and any additional instruments that may be requested by the surgeon. Both a saw and an amputation knife should always be included in the setup.

(2) Other items needed.

(a) A pneumatic tourniquet may be used, as ordered by the surgeon.

(b) A rongeur.

(c) A bone-cutting forceps.

(d) A periosteal elevator.

(e) A bone raspatory.

(f) An asepto syringe.

(g) An injection syringe and needle.

(h) A basin is used for the specimen.

d. **Preparation of the Patient.**

(1) Anesthesia. General (inhalation) anesthesia is used.

(2) Position. The patient is placed in a supine position with the knee of his affected leg flexed and the leg supported.

(3) Surgical prep and drape. The area is prepped and draped as described previously (see paras 1-27d, e; 5-3c).

e. **Special Precautions**. These are as described in paragraphs 5-3 and 5-4.

f. **Handling of Specimen**. If bone from the amputated leg is to be sent to the bone "bank," it is processed as previously described (see para 2-13). All specimens are labeled with the appropriate information, and the amputated leg is disposed of according to hospital policy.

g. **Suturing Type Usually Used.**

(1) Chromic gut size 2-0 or 3-0 on curved, cutting-edge needles- used to close fascia and muscle-interrupted stitches.

(2) Fine nylon or stainless steel wire size 5-0 or 4-0 used to close the skin flaps.

h. **Comparison with Amputation of Other Limbs**. The specialist prepares for and assists with other amputations in a way similar to that described above. Necessary modifications are made in the size of instruments and in the draping and positioning procedure, according to the area involved.

5-33. **TENOPLASTY OF FINGERS**

a. **Definition**. This procedure is the operative repair of severed tendons in the fingers.

b. **Indications**. The operation is indicated when a tendon (or tendons) is transected, since the hand depends for its normal function upon the adequate movement of its small joints. This movement is attained through the functioning of the tendons.

c. **Special Preparation of the Operating Room**.

(1) Instruments. The basic setup is as indicated on the instrument card for tendon repair of the hand. Additional instruments requested by the surgeon for the case are included in the set.

(2) Other items needed.

(a) A pneumatic tourniquet.

(b) Plaster splint and elastic bandages.

(c) Metal splints for the hand and arm, if ordered by the surgeon.

(d) Stools for the surgeon and his assistant to sit upon.

(e) Electrocoagulation (Bovie) machine, if ordered.

d. **Preparation of the Patient.**

(1) Anesthesia. Regional nerve block anesthesia is usually preferred.

(2) Position. The patient is placed in a supine position with the affected arm extended and supported.

(3) Surgical prep and drape. The area is prepped and draped in a similar manner to that described previously.

e. **Special Precautions.** These are the precautions discussed previously (see para 1-15e).

f. **Handling of Specimen**. If a specimen is obtained, it is processed for the laboratory as described previously (see para 2-11).

g. **Sutures Usually Used.**

(1) Silk or monofilament (single strand) stainless steel wire sutures, size 34- or 35-gauge, 10 inches and 18 inches long are used on straight, Bunnell needles or fine, curved (3/8) needles. The short end of the wire is twisted tightly around the strand. This suture is used to approximate the severed tendon ends. The silk suture is used if the surgeon does an end-to-end union of the severed tendon; wire is often used for end-to-end pull-out sutures and is also usually used for tendon-to-bone fixation. The ends of the pull-out suture are brought through the skin and secured to a button.

(2) Chromic gut is used to approximate the tissue layers.

Section VIII. APPLICATION OF PLASTER CASTS

5-34. INTRODUCTION

a. **General.** Plaster-of-Paris casts are the most frequently used means of providing external support to maintain a desired position of a body part. Casts are often used following surgical procedures; as examples, a cast may be applied to hold the bone in position until it heals following open reduction of a fracture and following an osteotomy. Casts may also be applied following certain plastic surgical procedures. Since the OR specialist may often be required to assist with casting, he should be familiar with certain aspects concerning the application of casts. He should also know the types of casts.

b. **Definition.** Plaster-of-Paris is technically known as gypsum of anhydrous calcium sulfate. The equipment needed for application of plaster casts includes plaster bandage. This is a gauze impregnated with plaster-of-Paris. When the impregnated bandage is soaked in water, a chemical reaction occurs causing the compound to set or harden.

c. **Setting Time of Plaster.** There are three types of plaster: slow setting, fast setting, and extra fast setting. The slow setting, which is infrequently used, sets in approximately 18 minutes, the fast setting hardens in about 8 minutes, and the extra fast sets in about 4 minutes. Slow setting plaster is usually used in applying large casts, such as body casts or hip spicas, where it may take a few minutes to get to the next layer. The slow setting plaster gives the needed time. The fast and extra fast plaster is used for small parts such as an arm or leg, where extra time is not needed. Setting time of plaster can be adjusted by using the following techniques.

(1) Setting time can be retarded by:

(a) Adding sugar to the water used to soak plaster.

(b) Using cold water.

(c) Permitting excessive water to remain in the plaster roll after soaking.

(2) Setting time can be accelerated by:

(a) Adding salt to the water.

(b) Using warm water (not over 80ºF).

(c) Removing most of the water from soaked plaster.

5-35. TYPES OF CASTS

a. **Cylinder Cast**. See figure 5-9 for a long leg cylinder cast. The cylinder cast is the most commonly used type of cast, and therefore is the type with which the specialist most frequently assists. It is a rigid plaster dressing, which encases a limb made by wrapping rolls of plaster bandage around the limb. The cast should include the joint above and the joint below the affected site when it is applied to immobilize a part, as is the usual case (see para 5-35f below, for exception). It may be used following open or closed reduction of fractures of bones of the limbs or following operations on them. A cylinder cast may be either padded or unpadded. It may also be modified in some special ways. A cylinder cast that is modified is typed or classified in accordance with the modification (walking cast; wedge cast; and hanging cast).

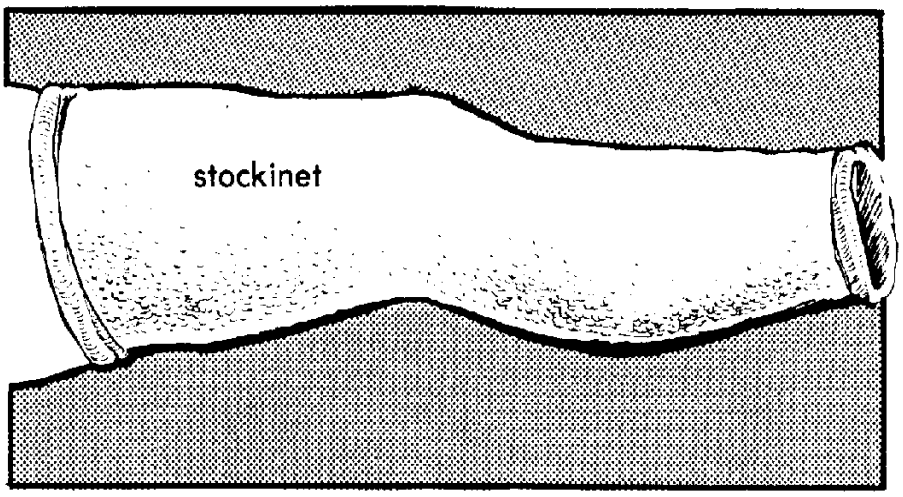
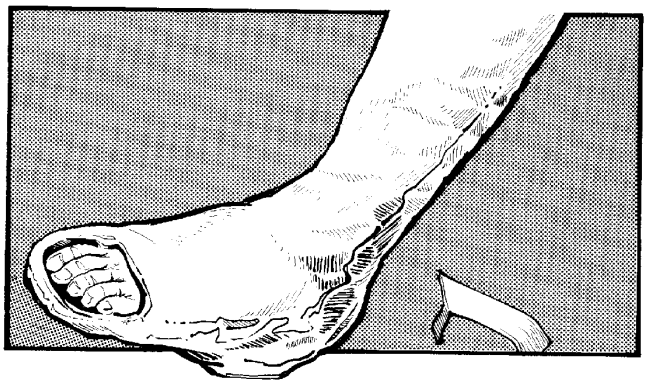


Figure 5-9. Long leg cylinder cast.

(1) Padded cast. For this cast, the skin is padded with sheet wadding and felt. A cylinder cast is usually padded and in particular, a padded cast issued for severe, fresh fractures, over infected areas, when excessive swelling exists or is anticipated or immediately after surgery.

(2) "Skin-tight" cast. This cast is unpadded except for the use of stockinette, if desired.

b. **Walking Cast (See Figure 5-10)**. This cast is made by the incorporation of a rubber "heel," a portion of tire tread, or other durable material under the foot encased in a cylinder cast, thus enabling the patient to be up and walking. The "walker" is fixed securely in place with plaster bandage.



Figureure 5-10. Walking cast.

c. **"Wedge" Cas**t **(See Figure 5-11)**. This is a cylinder cast from which a wedge-shaped piece has been removed to correct angulation (poor positioning) of a fracture following the application of plaster-of-Paris. The angulation is corrected by manual pressure, then a team member holds the edges of the cast together while another team member applies plaster bandage to maintain the correction. This procedure may be done following osteotomy of a bone, and following a recent fracture.

d. **Plaster Splint (Reinforcement Strip) (See Figure 5-12)**. This splint may be used for either temporary immobilization or for the immobilization of a part in certain instances. The splint is wet, applied to the posterior part of the extremity, and bound snugly in place with a bandage of cotton or elastic.

e. **Hanging Cast.** This cast is usually used when plaster is applied following open or closed fixation of fractures of the humerus. A heavy cylinder cast is applied to the arm (from axilla to knuckles) with the elbow flexed at a 90-degree angle. A loop of either wire or plaster is incorporated at the wrist, and the arm is suspended by passing a strip of muslin bandage through the loop on the cast. This cast does not immobilize the humerus, but reduces the fracture as the result of the traction exerted.

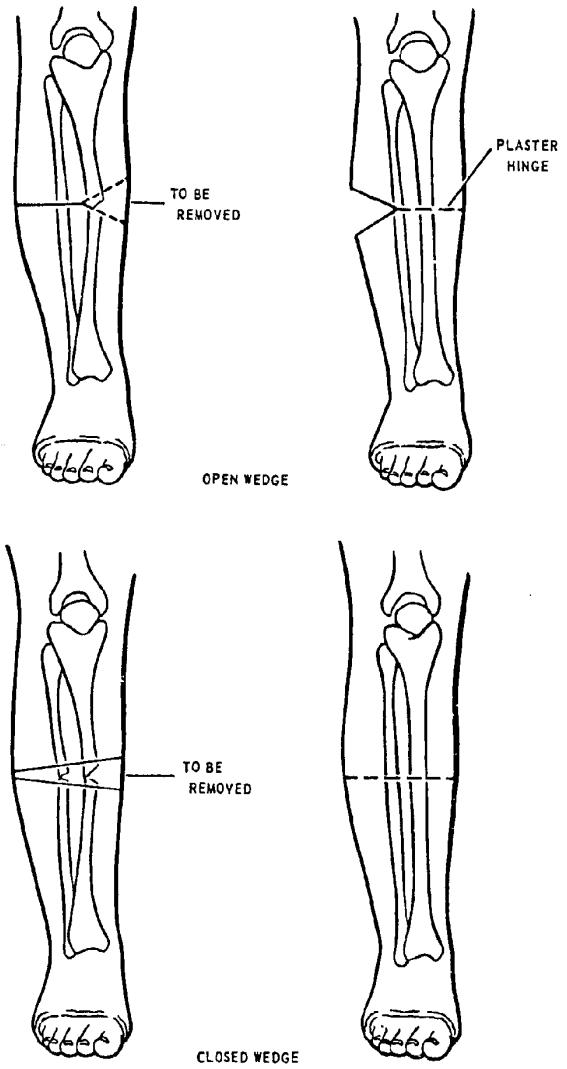


Figure 5-11. Wedge cast.

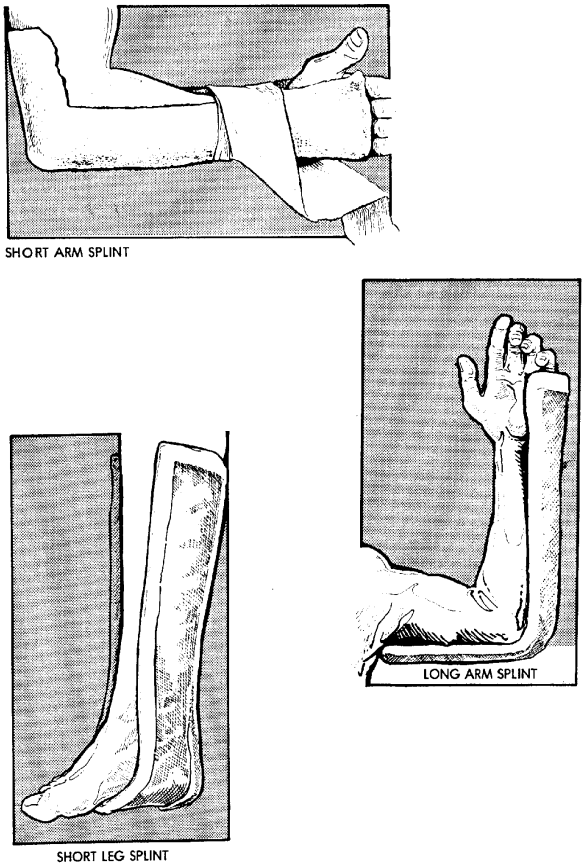


Figure 5-12. Plaster splints.

f. **Body Casts.** These casts are applied to immobilize the spine. Two kinds of body casts are used:

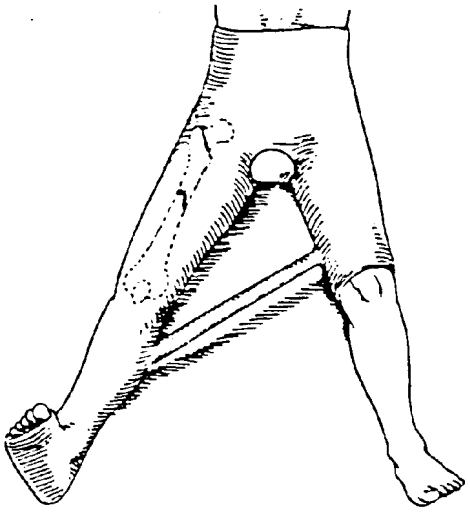
(1) Body jacket. This cast encircles the trunk and extends from the axilla to the hips. It may be used for immobilization following fractures or operations of the middle or lower portion of the spinal column and as treatment for back pain.

(2) Minerva jacket. This cast is used when the upper part of the spinal column needs to be supported and immobilized (as in fractures of the cervical or upper thoracic vertebrae). The cast includes the head, lower jaw, and the neck, and extends downward to the pelvis.

g. **Spica Cast.** In order to provide adequate immobilization of a joint, a cast must include the body part or parts adjacent to the joint. A spica cast includes a plaster "rope" brace. Examples of spica casts are discussed below.

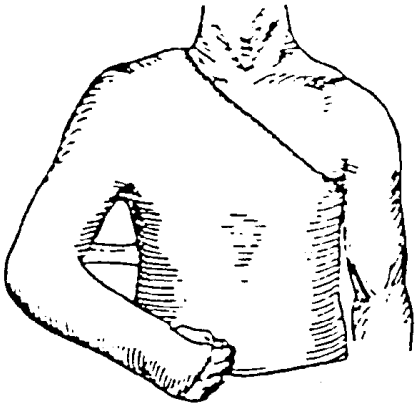
(1) Hip spica (see figure 5-13). This cast may be used following hip operations and certain fractures of the femur. There are several variations of the hip spica cast, but all are applied to include a part of the trunk and one or both legs (or a portion of the legs).

(2) Shoulder spica (see figure 5-14). This cast may be used following some operations on the shoulder or the humerus or for a fracture of the humerus. The cast includes the entire trunk and it extends to the knuckles of the affected arm, leaving the fingers and thumb free.



Note position of the plaster "rope," which adds to the strength of the cast.

Figure 5-13. Hip spica cast.



Note the "salute" position and the incorporation of a plaster rope for added strength.

Figure 5-14. Spica of shoulders.

(3) Spica of the hand (see figure 5-15 A and B). This cast may be used when it is desirable to obtain the most satisfactory immobilization of the thumb, and in some cases to hold a finger firmly.

(a) A spica of the thumb includes the forearm and extends to the end of the thumb (see figure 5-15 A).

(b) A spica or a finger includes the wrist and extends to the end of the finger (see figure 5-15 B).

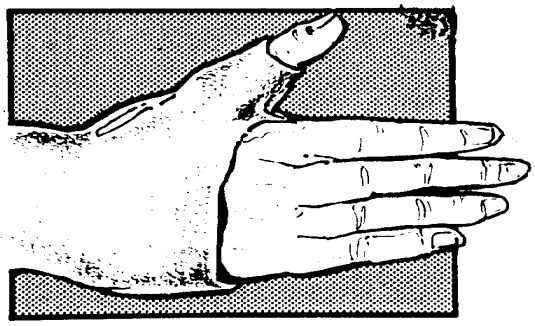


Figure 5-15 A. Spica of the thumb.

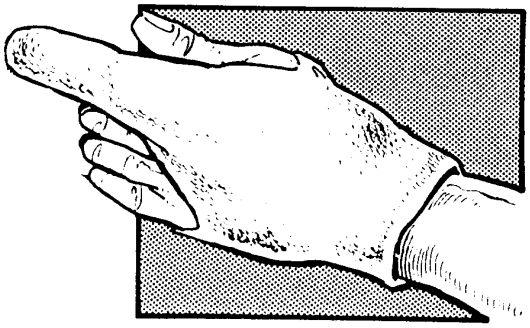


Figure 5-15 B Spica for finger.

5-36. PLACEMENT OF CASTS

Casts are applied in various lengths and sizes, depending upon the part of the body to be immobilized. A cast may be made by incorporating into it one or more plaster splints (reinforcement strips) or it may be fashioned by the use of plaster bandages only. The more usual procedure is to incorporate one or more splints into the cast. The particular method chosen by the surgeon depends upon such factors as the amount of stress that will be exerted on the cast and the expected duration of the patient's stay in it. If a cast is placed on a part that will undergo a considerable amount of stress (hip spicas, long leg casts) the cast can be applied more quickly and be made less bulky by the use of splints. All casts applied to immobilize a part should be long enough to encase the joint above and below the affected part. See figure 5-16 for a long leg cast.

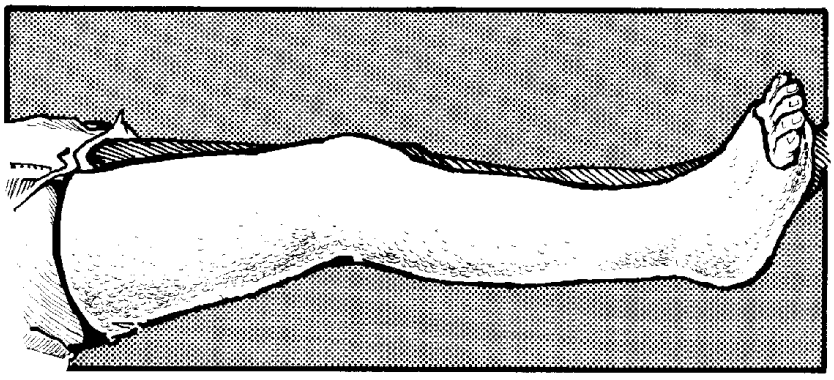


Figure 5-16. Long leg cast.

5-37. QUALIFICATIONS OF A GOOD CAST

a. The cast must fulfill the function of maintaining a desired position and must not be too tight or too loose.

(1) If the cast is too tight, it may impair circulation (evidenced by swelling, numbness, discoloration, or temperature change of the fingers or toes); and it may exert pressure upon bony prominences (this causes pain, and if the pressure is not relieved, may result in the breaking down of the tissue over the bone).

(2) If the cast is too loose, it will not maintain the position desired.

b. The cast should be as light and comfortable as possible, yet remain inflexible.

c. The entire length of the cast should be of about equal thickness.

5-38. ROLE OF THE SPECIALIST

The OR specialist's role in cast application is usually that of assisting the surgeon or the cast room personnel. The specialist who is knowledgeable concerning them contributes greatly toward the successful application of a cast and thus toward the patient's recovery. The specialist contributes greatly toward the successful application of a cast and thus toward the patient's recovery. The procedures for which the specialist is responsible have to do with the preparation of the patient; preparation of the supplies, equipment, and work area soaking and handling the plaster, and holding the part to be casted. When ordered, the specialist will also have the duty of cutting the cast.

5-39. PRINCIPLES OF APPLICATION

a. **Introduction.** The aim of the surgical team in the application of plaster is to produce a good cast. Success in achieving this goal depends upon adherence to principles, which should be observed whenever a cast of any type is to be applied. These principles are set forth in the ensuing text (b through e).

b. **Preparation of the Patient.**

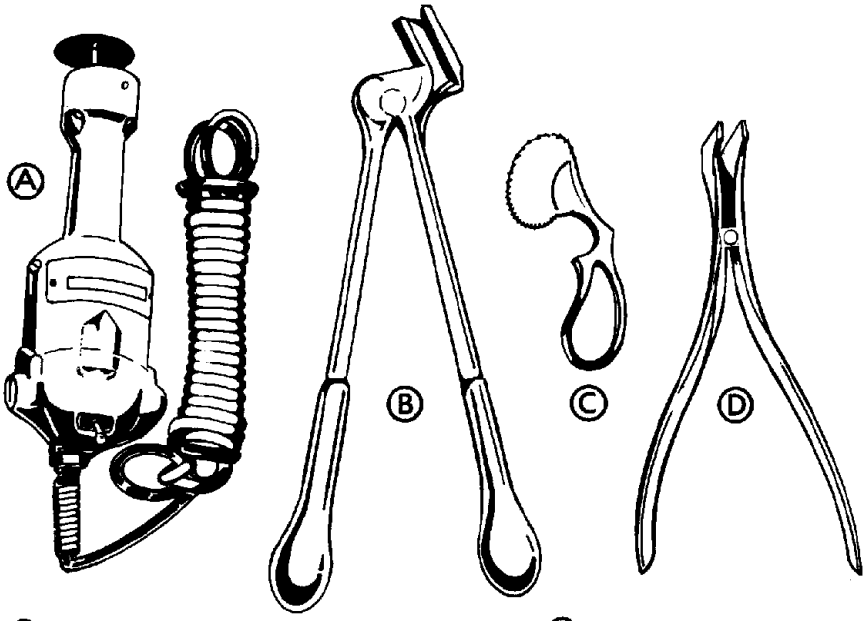
(1) The patient must be prepared physically and mentally for this procedure. The specialist explains what is to be done and allays any fears. He tells the patient that casting the injured part will help relieve pain. The specialist positions him as comfortably as possible, for it may take a while to complete the procedure.

(2) The specialist prepares the patient's skin in the area to be casted. This is done to help prevent irritation to the skin and to keep it as comfortable as possible. The skin should be inspected for ulcers and rashes. The specialist should check local policy before preparing the patient. The usual preparation is to wash the area with soap and water, dry it well, and dust it with powder. When the cast is applied immediately following surgery, no additional preparation of the skin is done.

c. **Preparation of Equipment and Supplies.** The specialist should make sure that all items needed are at hand, because there must be no interruption once the application of a cast is started. To stop the procedure even temporarily may cause a cast to become laminated (layered) and thus weakened. Therefore, the specialist should prepare and have ready the following items:

(1) Plaster rolls and splints. An adequate supply of these in the appropriate width for the cast to be applied should be placed on the worktable; they should be unwrapped and ready for use. (Standard items of plaster bandage include plaster rolls in widths of 3, 4, and 6 inches, as well as a plaster splint 4 x 15 inches for the arm and a splint 5 x 30 inches for the leg.)

(2) Instruments (see figure. 5-17). These are used for trimming and cutting casts (monovalving and bivalving, e(3) below) and are mostly of a cutting type. A cast knife and a pair of bandage scissors are needed for trimming. An electric saw or a cast knife and a cast spreader are used for monovalving and bivalving.



A Electric cast cutter.
B Plaster shears.
C Plaster saw.
D Plaster cast spreader.

Figure 5-17. Cast-cutting and trimming instruments.

(3) Padding (see figure 5-18).

(a) The materials used for padding are stockinette, sheet webril, and felt or sponge rubber.

(b) The padding is placed before the plaster is applied. Most surgeons prefer the use of stockinette and sheet wadding as basic padding (see figure 5-18). The specialist usually measures, cuts, and applies the stockinette.

(c) All bony prominences are protected with an additional pad of felt or sponge rubber (see figure 5-18). The pad is made by cutting it so that the material surrounds the prominence instead of pressing directly upon it. When felt is used, it is never applied directly upon the skin; stockinette or sheet wadding is used beneath it. (In figure 5-18, the stockinette is omitted and the fitted pads are moved from the prominence for clarity of illustration.) Stockinette not only protects the skin under the cast, but it also absorbs perspiration and prevents body hair from becoming embedded in plaster.

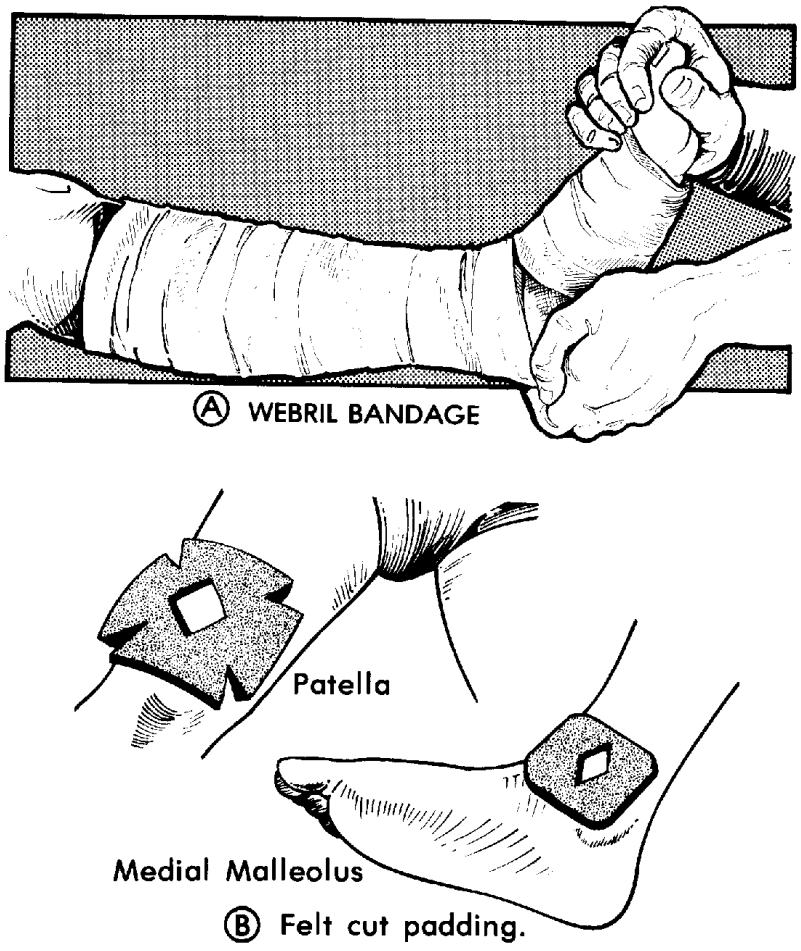


Figure 5-18. Padding for casts.

(d) In the lower limb, points requiring pads are the heel, malleoli, the patella, the head of the fibula, and the greater trochanter (see figure 5-19).

(e) In the upper limb, the prominences are the inner epicondyle of the humerus, the tip of the elbow, and the styloid process at the wrist (see figure 5-19).

(f) Prominences of the torso are the sacrum and the anterior superior iliac spines (see figure 5-19). In addition, provisions should be made for the intake of food and distension of the abdomen when applying a body cast; otherwise, a portion of the cast must be cut out. Adequate space for the abdomen can be provided by inserting a folded towel beneath the stockinette over the abdomen. The towel is removed when the plaster hardens.

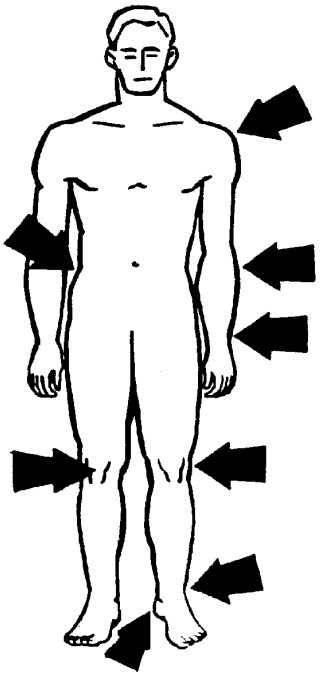


Figure 5-19. Bony prominences that should be padded before application of casts.

(4) Buckets of water. Tepid water (70º to 80º F) is used for soaking plaster bandages. The specialist should exercise care to ensure that the water is neither too hot nor too cold, since unsatisfactory soaking of the plaster could result, and the plaster would not be the right consistency to be applied. The water should feel neither hot nor cold when tested on the specialist's wrist. In addition, the specialist should prepare two buckets of water if a large cast is to be applied to prevent over saturation of the water with plaster. An excessive amount of plaster in the water prevents the bandages from becoming wet throughout. Usually it is necessary to change buckets after soaking five or six rolls.

(5) Protective covering. Paper and a piece of rubber or plastic sheeting is also needed. The paper (wrapping paper or newspaper) should be spread on the floor in the area being used for casting. The rubber sheeting should be placed beneath the part of the patient being casted in order to protect the table and linen from spillage of plaster.

(6) Soaking splints. A plaster splint is soaked by dipping it and drawing it rapidly through the water. The splint is then placed on a flat, smooth surface and the excess water is expressed from it by running the palms of the hands firmly over it.

(7) Soaking the plaster bandage rolls.

(a) The rolls should be placed on end and covered by the water in the bucket to allow complete water absorption.

(b) The bandages should not be disturbed while they are soaking because the plaster is easily washed out of the bandage.

(c) The rolls should be left in the water until the air bubbles stop escaping from the bandage. (This indicates that the bandage is sufficiently saturated with water.)

(d) The roll is then grasped by both ends, removed from the water, the ends compressed by the fingers and palm of each hand (to prevent the plaster from being squeezed out at the ends), and gently squeezed and twisted slightly (not wrung) to remove excess water. Too rapid or too vigorous squeezing distorts the roll and forces out too much water. Too rapid or too vigorous squeezing distorts the roll and forces out too much water, leaving the plaster too dry. (A roll should not be returned to the water once it has been removed, as to do so makes it useless.) Plaster that is too dry or that is over-soaked might dry too fast is unsatisfactory for use. The plaster bandage should be just dripping wet. If left excessively wet, the central part of the roll will telescope and the roll will be useless.

NOTE: A bandage that has dry spots should be discarded.

(e) Another way to avoid the waste of plaster is by soaking one roll at a time. When half of the first roll is applied, another roll is put into the water to soak. In this way, the specialist keeps just ahead of the person applying the cast.

(f) When the cast is near completion, the specialist should ask whether another roll is needed. Delay in having the next roll ready may result in lamination of the cast.

(8) Handing the plaster roll. When the roll has been squeezed, the specialist finds the end of the bandage, unrolls about 2 inches of the plaster, and hands it to the team member applying the cast, so that the roll is placed in the right hand and the end of the bandage in the left hand. This enables the team member to apply the plaster in one smooth, continuous movement.

d. **Smoothing the Plaster Bandage.** The team member applying the cast strokes and molds the plaster constantly as it is applied in order to make it conform to the body part and to make a strong, cohesive cast with a smooth surface.

e. **Cutting or Trimming the Cast.** This is done after the plaster is set. A cast is trimmed to make the edges smooth, thus preventing the injury of tissue and making the cast more comfortable. In all procedures of trimming or cutting a cast, the surgeon marks the part to be trimmed or cut. If the specialist is assigned to trim or cut the cast, he should carefully cut through the cast on the marked lines. He should avoid dripping pieces of plaster (plaster "crumbs") inside the cast since this could result in discomfort to the patient and could damage healthy tissues. The surgeon may order a cast cut for one or more of several reasons:

(1) To correct the length. A cast may be applied somewhat above and below the desired area. When this is done, the cast must be cut to correct the length, as marked by the surgeon.

(2) To make a "window." A "window" is a rectangular block cut from a cast. Usually, a window is cut to relieve pressure or to allow observation of a wound. A window should never be cut in a body jacket or a spica cast until the plaster has thoroughly dried because of the tendency of these casts to buckle. Whenever the specialist cuts a window from a cast, he should replace the piece cut out and secure it with adhesive tape or bandages; otherwise, the tissue underlying the window may swell ("window edema") and cause circulatory disturbances and ulceration at the edges of the window.

(3) To split the cast. A surgeon may mark a cast to be split lengthwise in order to prevent the occurrence of circulatory disturbance. The cast maybe split by either monovalving or bivalving it.

(a) Monovalving a cast is splitting it lengthwise, usually on the anterior aspect of the limb.

(b) Bivalving a cast is splitting it lengthwise on both sides. If the cast is on a limb, it is split on the medial and the lateral aspects of the limb; if it is on the body, it is cut down the sides. A cast is often bivalved so that one part of the cast can be removed to dress wounds or prepare the skin for surgery. When the procedure is completed, both parts of the cast can then be secured with bandages.

5-40. PROCEDURES IN APPLICATION

In the ensuing text, procedure is given for applying a cast of the forearm. The steps set forth are those used for the application of any cast, with the necessary adaptations made in the fitting of padding material and in selecting the size and amount of plaster bandages for use.

a. **Padding the Arm.**

(1) First, the specialist prepares the stockinette; he measures it for length, cuts a hole for the thumb, and applies it.

(2) A piece of felt or sponge rubber is then cut to fit over the styloid process of the wrist.

(3) Sheet wadding is applied around the hand and arm to fill in the hollow spaces.

b. **Preparing Plaster Bandage Rolls.** The specialist soaks one roll of plaster, squeezes the excess water from it, and hands it to the surgeon as described above (see para 5-39c(8)). He keeps the surgeon supplied with bandages as described above.

c. **Applying the Plaster Bandage.**

(1) The bandage is permitted to lie where it falls naturally from the roll. Plaster bandage is never twisted or reversed, as is done with ordinary bandage. If it is necessary to alter the direction of the roll or to mold the plaster smoothly on the limb, a tuck is made by taking up the slack in the bandage, then rubbing the folded tuck flat and smoothing it.

(2) The arm is maintained in the position desired until the cast sets. The wrist is usually placed in moderate flexion.

(3) If reinforcement strips (plaster splints) are used, each is tied into the cast with a roll of plaster bandage.

(4) The team member who holds the arm must avoid digging his fingers into the plaster. He is allowed to touch the wet plaster with his palms only, and he must keep moving his hands by sliding them back and forth constantly in order that he will not put enough pressure in one place to distort the shape of the cast and to produce a pressure area.

(5) The plaster is rubbed and smoothed constantly as it is applied.

(6) The cast is not made any heavier than is necessary because a heavy cast is burdensome to the patient.

(7) Plaster crumbs should not be allowed to drop between the stockinette and the skin.

(8) Before the final roll is applied, the surgeon folds the stockinette over the edges of the cast on each end and applies plaster over it. He may also roll and mold the plaster at the edges at this time. This protects the patient from the rough edges of plaster.

d. **Trimming and Cutting the Cast.** When the plaster is set, the specialist, if ordered to do so, trims it around the thumb and the palm as marked by the surgeon. This trimming allows the patient full range of motion of the fingers if the surgeon desires that the cast be monovalved or bivalved, he marks it at the area he wishes it cut. The cast may be cut using an electric saw or cast-cutting knife.

Continue with Exercises

EXERCISES, LESSON 5

INSTRUCTIONS. Answer the following exercises by marking the lettered response that best answers the question or best completes the incomplete statement or by writing the answer in the space provided.

After you have completed all of these exercises, turn to "Solutions to Exercises" at the end of the lesson and check your answers. For each exercise answered incorrectly, reread the material referenced with the solution.

1. The type of cast which provides extra mobilization with a brace is called a:

   a. Body cast.

   b. Spica cast.

   c. Hanging cast.

   d. Cylinder cast.

2. You should have all necessary equipment at hand when a cast is to be applied. Stopping the application of plaster may produce what undesirable result?

   a. Lamination.

   b. Hardening.

   c. Softening.

   d. Wedging.

3. Arthrodesis of the knee joint is done in order to bring about what result?

   a. Restore movement.

   b. Produce immobilization.

   c. Establish limited movement.

   d. Depends upon individual cases.

4. Upon unrolling the end of a soaked plaster bandage roll, you note that the bandage is dry in spots. What should you do?

   a. Give it to person applying cast.

   b. Pour water on dry spots.

   c. Return it to the water.

   d. Discard it.

5. When rolls of plaster bandage are being soaked, a fresh bucket of water should l ikely be used after soaking how many rolls?

   a. 2 or 3.

   b. 5 or 6.

   c. 9 or 10.

   d. 14 or 15.

6. A patient is scheduled to have a closed reduction with traction of a femoral shaft fracture. You are assigned to circulate. Which of the following sterile instrument(s) will be needed?

   a. Scalpel.

   b. Hemostats.

   c. Retractor.

   d. Suture scissors.

7. Items that should be in readiness for the application of most plaster casts include:

    a. Stockinette.

    b. Plaster rolls.

    c. Plaster splint.

    d. Bandage scissors.

    e. All of the above.

8. Which of the following items will probably be included in the setup for tenoplasty of the fingers

    a. Nerve tape.

    b. Tenotomy scissors.

    c. Pneumatic tourniquet.

    d. Screwdriver and screws.

9. When you are cutting or trimming a cast, you should avoid dropping plaster crumbs inside the cast because the presence of crumbs often results in:

    a. Buckling of cast.

    b. Layering of the cast.

    c. Damage to the patient's tissues.

    d. All of the above.

10. What kind of tissue specimen will be obtained during a closed reduction with traction of a femoral shaft fracture?

    a. Cartilage.

    b. Muscle.

    c. Bone.

    d. None.

11. Closed reduction of a fracture with traction is commonly done on the ____ bone.

    a. Fibula.

    b. Radius.

    c. Clavicle.

    d. Calcaneus.

12. Open reduction of fractures is a means of fixing broken fragments with various appliances through an open wound.

    a. True.

    b. False.

13. Another name for a sliding bone graft is

    a. Inlay.

    b. Onlay.

    c. Osteotome.

    d. Subcapital.

14. A type of fracture, common in the elderly, which frequently results from a wrench or strain is called:

    a. Stellate fracture of acetabulum.

    b. Subcapital fracture of femur.

    c. Fracture of femoral shaft.

    d. Arthrodesis.

15. When is a patellectomy done?

    a. When the menisci are damaged.

    b. When the patella is fractured.

    c. When patellar ligaments are damaged.

    d. When the patella is unsalvageable or diseased.

16. Recurring dislocation of the shoulder may be treated by:

    a. Nicola operation.

    b. Bankart operation.

    c. DePalma operation.

    d. Magnuson operation.

    e. Any of the above.

17. Closed suction drainage may help prevent:

    a. Separation of bone chips.

    b. Excess swelling.

    c. Granulation.

    d. Scar tissue.

    e. All the above.

SITUATION FOR EXERCISES 18 AND 19. A patient is scheduled to have an open reduction of the femur, to be fixated using a plate and screws. You are assigned as the scrub.

18. The surgeon has just finished painting the leg with antiseptic solution. When should you start handing the sterile drapes?

    a. Immediately.

    b. After handing a scalpel.

    c. After handing towel clips.

    d. When the prep solution is dry.

19. Which of these items may be used to help control bleeding of the femur?

    a. Cautery.

    b. Free tie.

    c. Bone wax.

    d. Suture-ligature.

SITUATION FOR EXERCISES 20 AND 21.
You are assigned to prep a patient who is scheduled to have an open reduction of the distal third of the tibia.

20. The patient's foot appears very grimy. As part of the prep of the foot, what should you do in an effort to free it from dirt?

    a. Scrape it.

    b. Rinse it.

    c. Soak it.

    d. Nothing.

21. Upon completing the shave, what should you do to the shaved area?

    a. Scrub it with antibacterial detergent.

    b. Paint it with antiseptic solution.

    c. Wrap it with elastic bandage.

    d. Secure a tourniquet above it.

SITUATION FOR EXERCISES 22 AND 23.
A patient is scheduled for "excision of torn cartilage of the knee joint."

22. What will the surgeon remove?

    a. Menisci.

    b. Patella.

    c. Popliteal exostosis.

    d. Head of the gastrocnemius.

23. The patient prep for this operation is the same prep that is used for what other operation?

    a. Closed reduction with traction of a femur.

    b. Autogenous bone graft to a femur.

    c. Patellectomy.

    d. Tenoplasty.

SITUATION FOR EXERCISES 24 AND 25.
A patient is scheduled to have an arthroplasty of his right knee. You are the circulator.

24. You should place the patient in a modification of what position?

    a. Prone.

    b. Supine.

    c. Lateral.

    d. Trendelenburg.

25. What modification should you make in the patient's position?

    a. Tilt head of table skyward.

    b. Tilt foot of table skyward.

    c. Place knee in position to be flexed.

    d. Put his head on the cerebellar headrest.

SITUATION FOR EXERCISES 26 through 30. Each numbered item in Column I can be matched **BEST** by one of the lettered choices in Column II. You may use any choice in Column II for as many exercises as you wish.

COLUMN I	**COLUMN II**
Distinguishing characteristics of casts.	**Types of casts.**
___26. Made by the incorporation of some durable material such as a rubber heel under the foot encased in a cast.	a. Wedge cast.
___27. A cast that does not immobilize the fractured bone.	b. Hanging cast.
___28. A cast from which a piece is removed to correct poor positioning of the plaster-encased fracture.	c. Walking cast.
___29. A cast used to immobilize the spine.	d. Spica cast.
___30. A cast applied following certain operations of the hip.	e. Body cast.
___31. Reduces a fracture as the result of the traction exerted.	

Check Your Answers on Next Page

SOLUTIONS TO EXERCISES, LESSON 5

1. b (para 5-35g)
2. a (para 5-39c)
3. b (para 5-24a)
4. d (para 5-39c(7)(d) NOTE)
5. b (para 5-39c(4))
6. a (para 5-8c(1))
7. e (paras 5-39c(1), (2), and (3))
8. c (para 5-33c(2)(a))
9. c (para 5-39e)
10. d (para 5-8f)
11. d (para 5-8h(2))
12. a (para 5-9a)
13. a (para 5-10c(2))
14. b (para 5-11b(1))
15. d (para 5-21a)
16. e (para 5-29a)
17. e (para 5-31a(2))
18. d (para 5-8e(2)(c))
19. a (para 5-9c(2))
20. c (para 5-3c(2))
21. a (para 5-3c(2))

22. a (para 5-25a)

23. c (para 5-25c)

24. b (para 5-23c)

25. c (para 5-23c)

26. c (para 5-35b)

27. b (para 5-35e)

28. a (para 5-35c)

29. e (para 5-35f)

30. d (para 5-35g)

31. b (para 5-35e)

End of Lesson 5